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DEADMAN'S BASIN DAM

MANUAL FOR OPERATION AND MAINTENANCE

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Water Resources Division
Department Of Natural Resources And Conservation
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Helena, MT 59620-1601

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PROJECT DESCRIPTION

OVERVIEW

The Deadman's Basin Reservoir is an off-stream storage impoundment for water diverted from the Musselshell River. Both the dam and the dike at the reservoir are in Wheatland County adjacent to the county line separating Wheatland and Golden Valley Counties (Figure 1). The project is approximately 9 miles upstream of the town of Ryegate, Montana and approximately 4 miles east of the town of Shawmut, Montana off of U.S. Highway 12 (Figure 2). Figure 3 provides a general layout of the access roads, dam, dike and gatehouse. Figure 4 provides a general location of the monitoring wells at the dam and dike.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Deadman's Basin Water Users Association (herein called the "association") operates and maintains the dam.

The dam, dike, supply canal, and delivery canals were completed in 1941. Water from the reservoir is used primarily for irrigation water supply. The reservoir is also used for water-based recreation with recreation facilities along the south side of the reservoir. Some cabins are located on the southeast side of the reservoir between the dam and the dike.

SUPPLY CANAL

Water is diverted from the Musselshell River to the reservoir by an 11.5 mile long supply canal. The supply canal consists of a concrete diversion and headgate structure on the Musselshell

River; several dams, overflow structures, and drop structures along the canal; and a concrete drop structure into the reservoir. The canal's design capacity is 600 cfs.

In August 1997, a large scour hole was discovered at the diversion structure on the Musselshell River. The repairs consisted of diverting the Musselshell River, compacting clay material in the eroded section, placing river material and large rock riprap to complete the backfill both upstream and downstream of the diversion structure. A void within the concrete diversion structure was filled with lean concrete. The repair was completed at a total cost of $195,672.

EMBANKMENT

The original earthen embankments consisted of a main dam and three small dikes. The type of soil used for the impervious fill is not known. In 1958 the embankment crest of the dam was raised 10 feet by adding material on the downstream side of the main dam, and by incorporating the three existing dikes into one and raising the height to match the main dam.

The dam is 60 feet high and 1,490 feet long, while the dike is 18 feet high and 2,950 feet long. An access road crosses the dike to the dam and cabin area.

OUTLET WORKS

The dam's outlet works consists of an inlet structure, horseshoe-shaped reinforced concrete tunnel, wet tower with two 60-inch by 60-inch cast iron slide gates with controls near the top of the tower, and an outlet structure. The outlet structure exits into an excavated canal where the water divides into the Barber and Careless Creek canals.

The outlet gates are operated with an electric motor with belts to turn the gates open or close. The electric motor can slide on a mount to operate either gate. If the electricity fails, the gates can be manually operated with a hand crank.

When the dam was raised ten feet in 1958, the walls of the gate tower were also raised 10 feet but the operating and emergency gate operating pedestals were not raised and remained at the same original elevation. Therefore, the floor of the gate tower (elevation 3,923 feet) is only two feet above the normal full pool elevation (elevation 3,921.0 feet). The electric motor used to operate the operating gate is located next to the gate pedestals at about elevation 3,926 feet. If the operating gate pedestal were to become submerged, there would be a problem opening the operating gate to release water from the reservoir.

SPILLWAY

There is no spillway at the Deadman's Basin Project.

DRAINS

There are no drains at the Deadman's Basin Project.

DELIVERY CANALS

Water released from the reservoir is delivered to the water users through the Barber and Careless Creek canals.

In August 1996, a large, open-chute drop structure in the Careless Canal (Drop No. 2) failed catastrophically. The repair consisted of rehabilitating the existing concrete chute entrance to accommodate a drop entrance into a 48-inch diameter, 380 feet long polyethylene pipe, placing a gravel filter under the pipe and exit structure to carry the groundwater, and a new concrete baffled exit structure. The project was completed in February 1997 at a final cost of $160,420.

Rehabilitation of the Barber Canal to increase its flow capacity from 200 to 300 cfs started in 1997. The U.S. Natural Resources Conservation Service (NRCS) completed a Phase I and Phase 2 report to check the feasibility of enlarging the canal and its structures, and prepared design reports. The cost of the two reports was $25,000.

The DNRC Helena office and Lewistown Regional Office completed plans and project documents for the second phase of the Barber Canal rehabilitation project. This phase included repair and enlargement of rock riprap stilling basins below three drop structures, canal bank stabilization using rock riprap, and canal excavation to increase capacity in the lower sections of the canal. The work was completed in fall of 1998. Total construction cost for this phase was $121,571.

The third and final phase of the Barber Canal rehabilitation was completed in May, 2001. HKM Engineering, Inc, was hired to design the project, and DebCon Inc. of Lewistown, Montana performed the construction work. The work included modification of the approach canal, reshaping of the canal, reconstruction of the county road crossing, replacement of an 80-foot drop structure, and installation of a new highway crossing into the Musselshell River. Total construction cost, including engineering design, was $664,387.

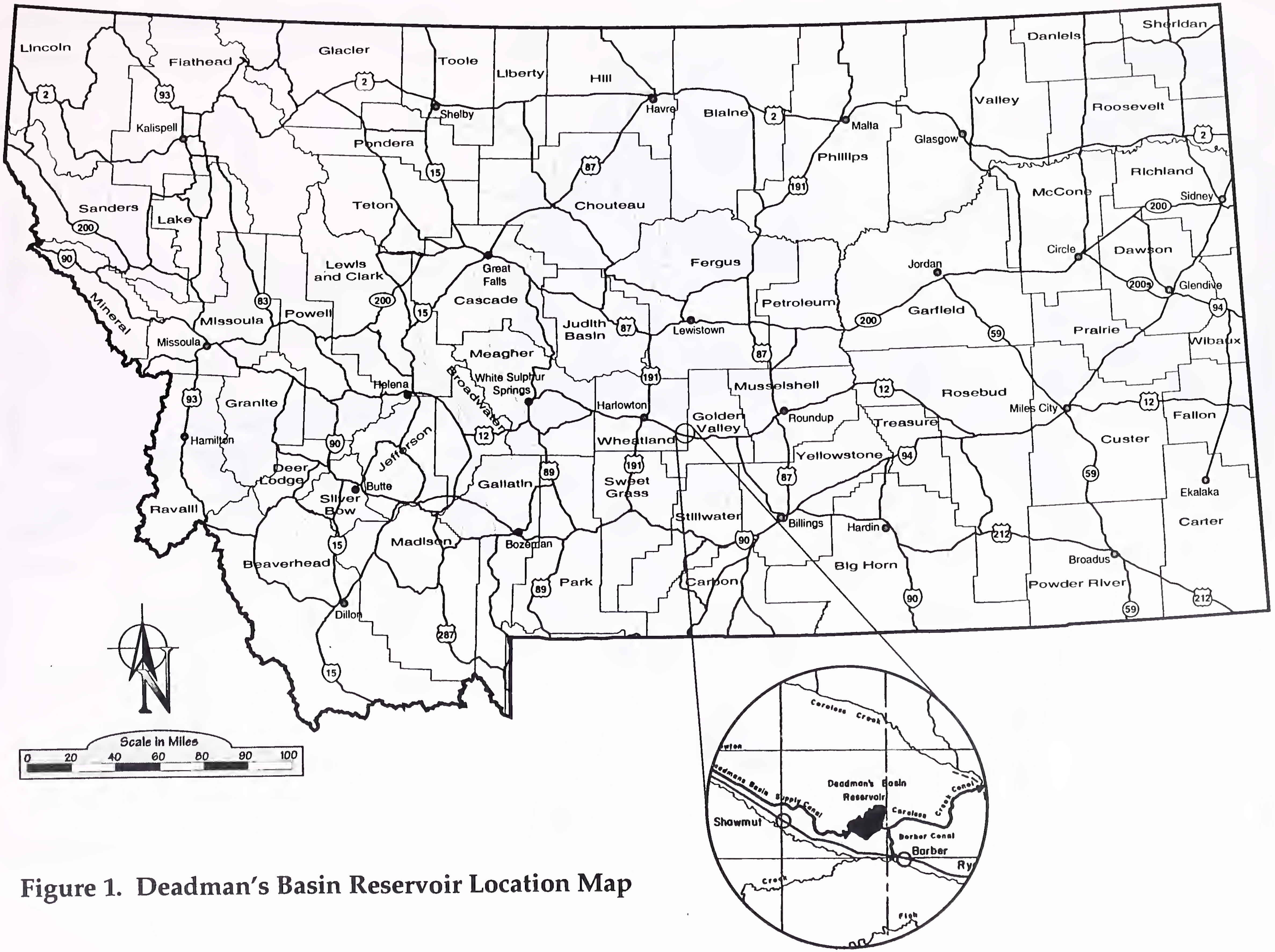


Figure 1. Deadman's Basin Reservoir Location Map

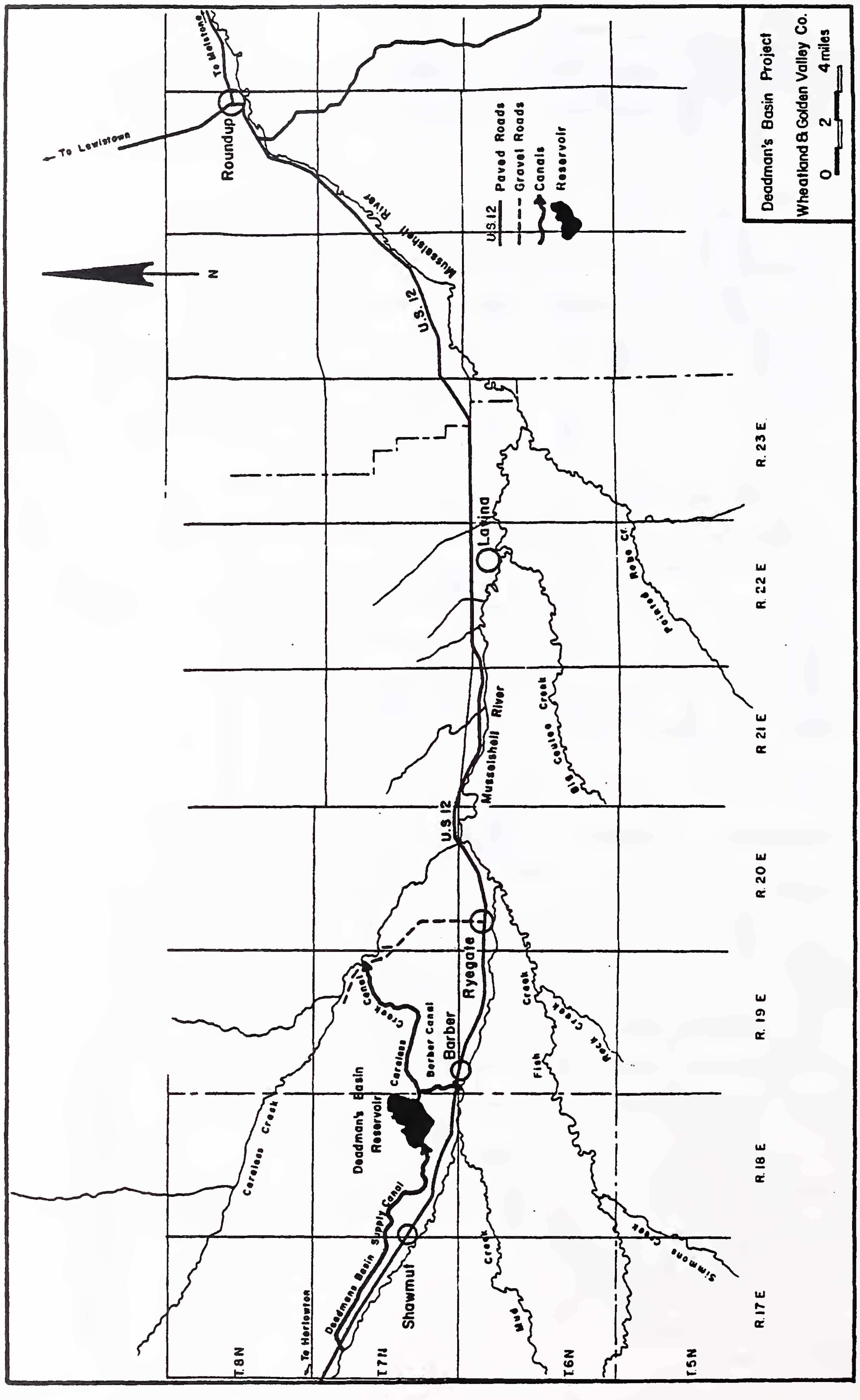


Figure 2. Deadman's Basin Project Map

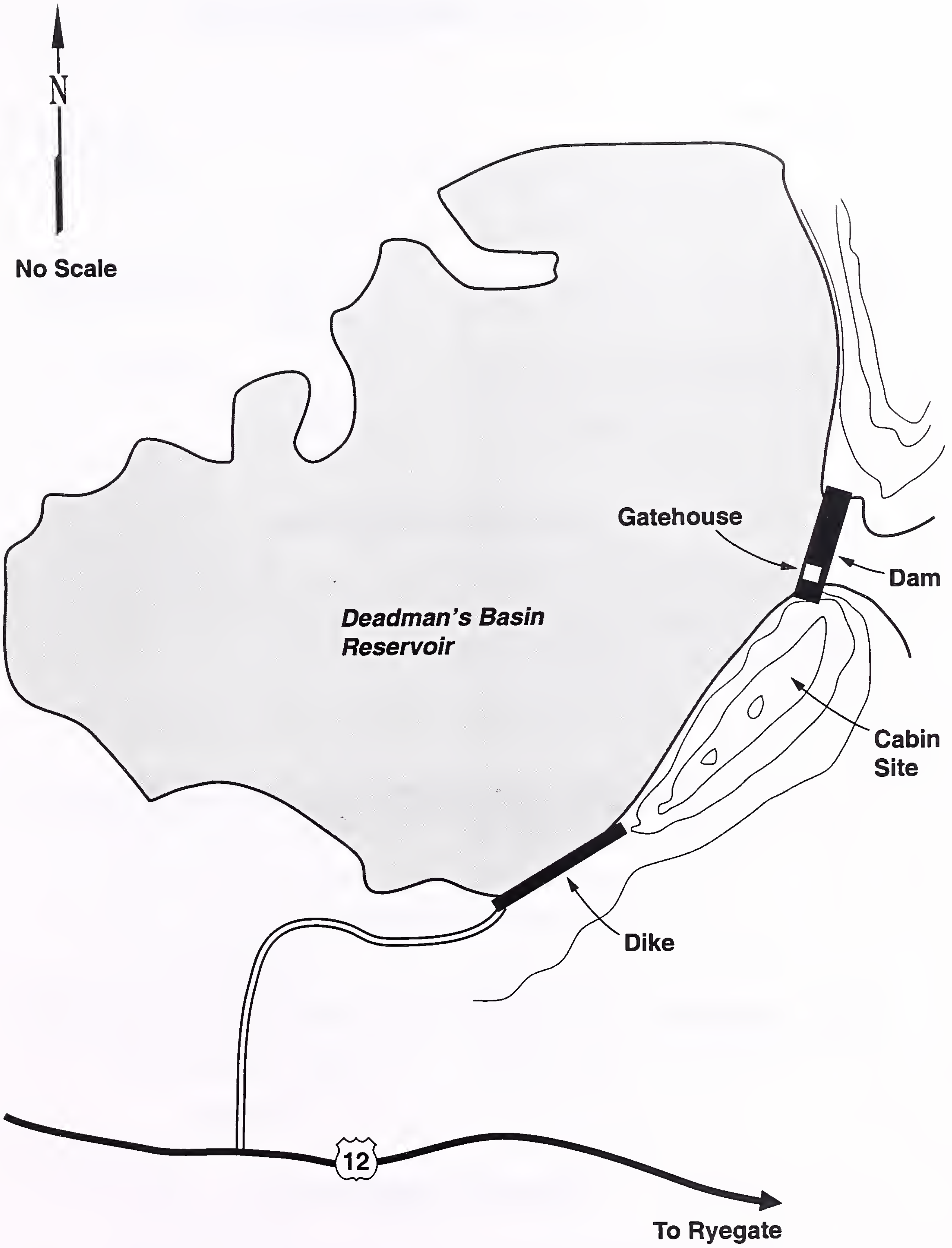
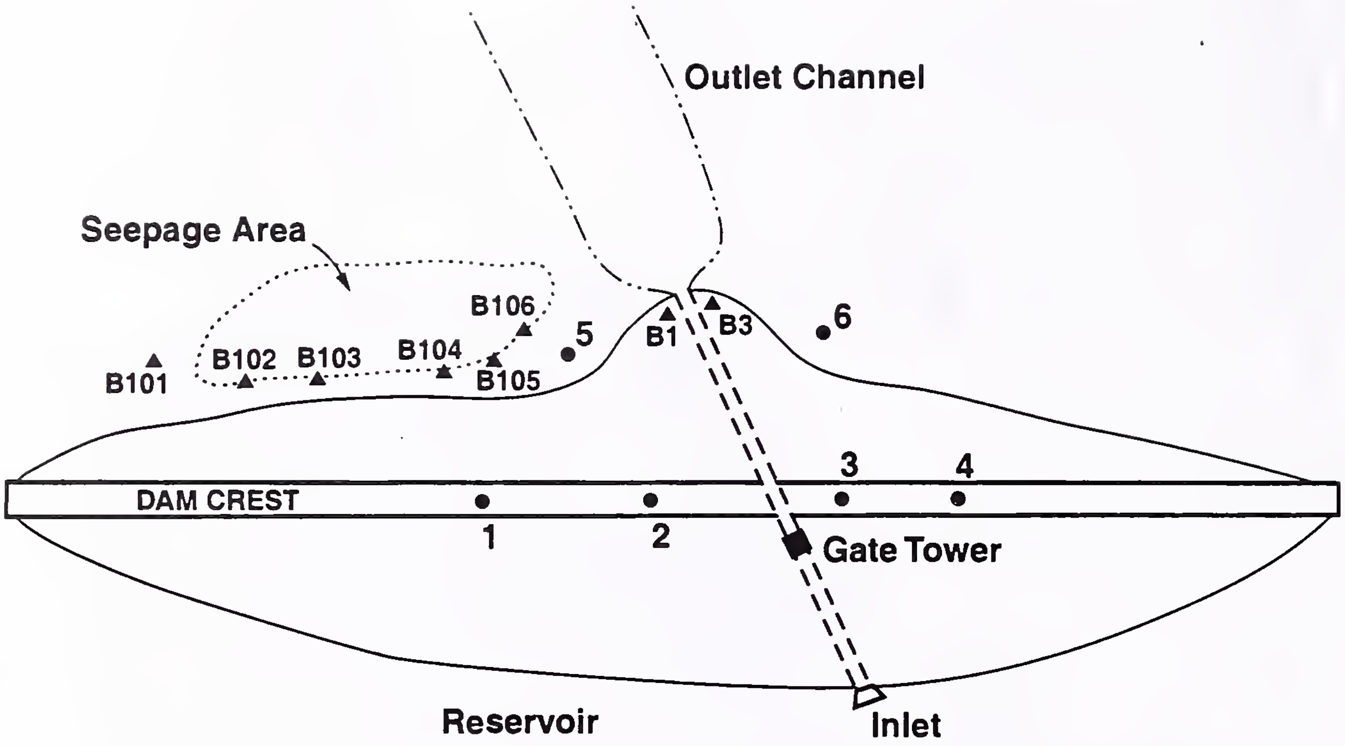
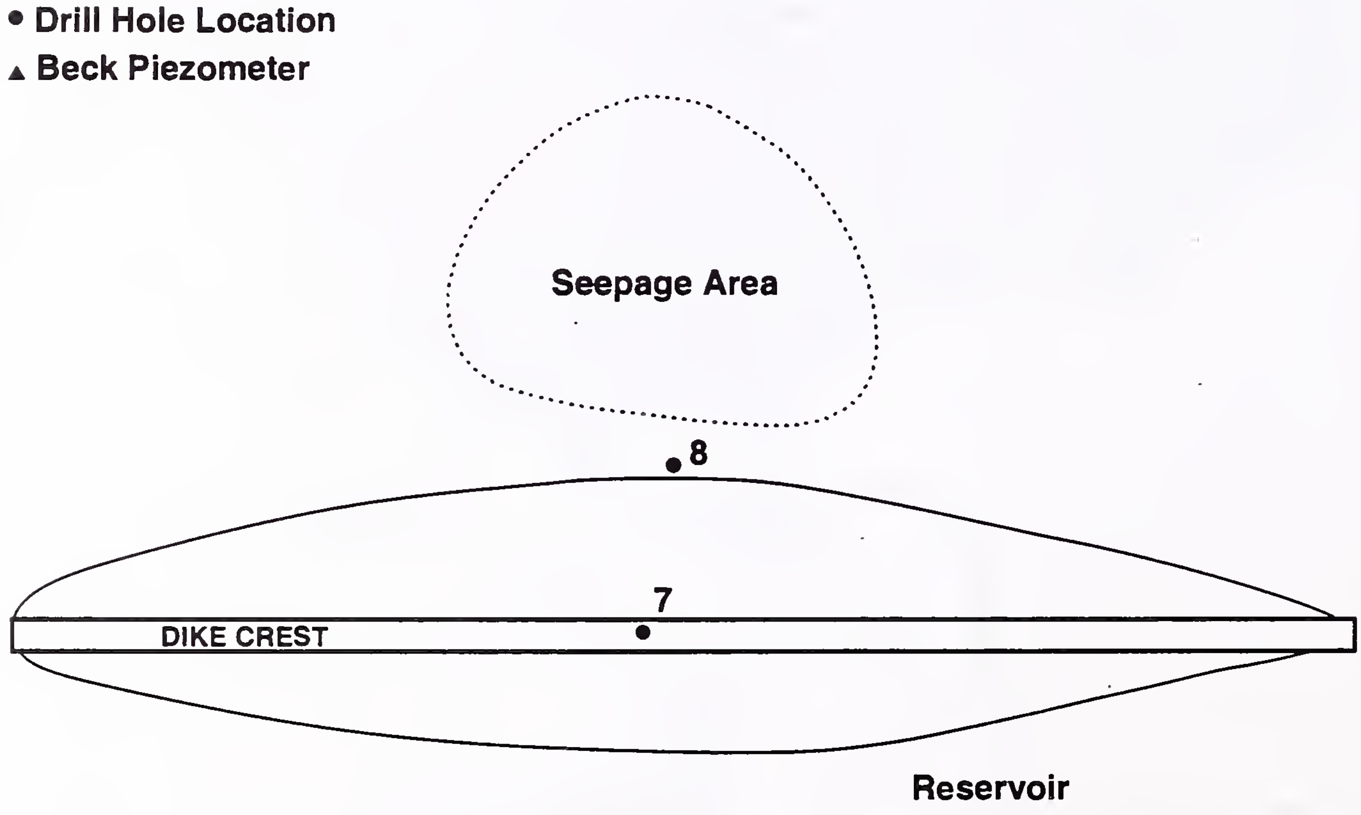


Figure 3. Deadman's Basin Reservoir General Layout



Deadman's Basin Dam



Deadman's Basin Dike

Figure 4. Deadman's Basin Monitoring Wells Location

STATISTICAL INFORMATION

1. General

a.	Owner	Montana Department of Natural Resources and Conservation (DNRC)
b.	Operator	Deadman's Basin Water Users Association
c.	Location	Dam - Section 25, Dike - Sections 35 and 36, Township 7 North, Range 18 East, MPM
d.	Latitude Longitude	46.34° 109.41°
e.	County--State	Wheatland--Montana
f.	Watershed Location	Musselshell River, Missouri River basin
g.	Drainage Area	7.3 square miles

2. Principal Elevations (feet above mean sea level)

a.	Minimum Dam Crest	3,931.7 feet
b.	Minimum Dike Crest	3,932.8 feet
c.	Outlet Works Tower Grate	3,923.0 feet
d.	Normal Full Pool	3,921.0 feet
e.	Top of Intake Tower	3,887.39 feet
f.	Design Intake Invert	3,872.0 feet

3. Reservoir

a.	Length of Maximum Pool (approximate)	2 miles
b.	Maximum Reservoir Level of Record	3,922 feet (June 1991)
c.	Surface Area (at normal full pool)	2,120 acres

4. Storage

a. Total Storage (pool at dam crest)	100,000 acre-feet
b. Active Storage (normal full pool)	72,218 acre-feet
c. Maximum Surcharge	23,182 acre-feet
d. Dead Storage	3,750 acre-feet

5. Hydrology

a. Inflow Design Flood	Probable Maximum Flood (PMF - 49,900 cfs peak flow) (maximum reservoir elevation 3,926.5 feet)
b. 100-Year Flood	706 cfs
c. 500-Year Flood	1,311 cfs

6. Embankment (Dam)

a. Type	Earthfill
b. Hydraulic Height	60 feet
c. Crest	
Length	1,490 feet
Crest Width	18 feet
Minimum Crest Elevation	3,931.7 feet
d. Downstream Slope	
above elevation 3,897 feet	1v on 2.3h
below elevation 3,897 feet	1v on 1.8h
e. Upstream Slope	
above normal full pool	1v on 1.7h
below normal full pool	1v on 3.0h

7. Embankment (Dike)

a. Type	Earthfill
b. Hydraulic Height	18 feet
c. Crest	
Length	2,950 feet
Crest Width	15 feet
Minimum Crest Elevation	3,932.8 feet
d. Downstream Slope	1v on 2h
e. Upstream Slope (above normal full pool)	1v on 2h
f. Upstream Slope (below normal full pool)	1v on 3h

8. Outlet Works

a. Size	Horseshoe-shaped, reinforced concrete tunnel (7.5 feet rectangle with 3.75 feet radius roof)
b. Length	300 feet
c. Control	Two 60-inch by 60-inch cast iron slide gates with vertical access tower and control from near dam crest
d. Discharge Capacity (pool at dam crest)	1,080 cfs
e. Trashrack	Yes

OPERATING PROCEDURES

The association operates Deadman's Basin Dam to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing an adequate supply of contracted irrigation water without exceeding safe storage or flow levels. The dam operator's specific responsibilities are to:

1. Operate the mechanical features of the outlet works
2. Coordinate filling of the reservoir and the release of water
3. Notify the SWPB of unusual occurrences such as impending floods or excessive seepage
4. Perform certain maintenance tasks
5. Monitor weather conditions
6. Monitor seepage

Typically, the out-going dam operator and the association, and the SWPB train a new dam operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage level, measurement of the rate of water release, and record-keeping.

The dam operator normally is available to observe the dam and perform operating functions daily during the filling and irrigation seasons, and weekly or monthly at other times. Communication among the dam operator, the association, and the SWPB usually takes place by telephone. There is a telephone in the gatehouse (**406-632-5821**). During emergencies or unusual occurrences, radio communication may be established so that the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (see **Deadman's Basin Dam Emergency Plan).**

METHOD AND SCHEDULE OF OPERATION

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The date that irrigation releases typically begin is May 1, but may vary from year to year with late April being the earliest. Irrigation releases usually end by September 30 as specified in the water purchase contracts. The actual dates that releases begin and end depend on the year's climatological and hydrological conditions.

Filling of the reservoir typically begins in October and is filled slowly during the winter months. The inlet canal is operated during the winter to minimize icing at the diversion structure and to reduce icing in the canal. Even when icing does occur, water continues to run through the canal under the ice. The primary filling period occurs during March and April. Filling also occurs during the irrigation season if there is a rainy period and there is extra water in the river that has not been "called."

The maximum full reservoir elevation is 3,921.0 feet with 72,218 acre-feet active storage.

Maximum Winter Storage: The maximum reservoir elevation for winter storage is 3,911.0 feet with 52,502 acre-feet of storage. This winter maximum helps prevent damage to riprap and the embankment from wind-driven waves and ice.

Minimum Winter Storage: The minimum reservoir elevation for winter storage is 3,892.6 feet with 21,940 acre-feet of storage. This winter minimum helps prevent freeze-thaw and ice damage to the outlet works inlet structure, minimizes water quality problems, and helps to maintain the fishery.

GATE OPERATION

The outlet works are to be used for controlling the release of irrigation water, and not for providing emergency flood relief.

With the reservoir full, the maximum capacity of outlet works is 1,080 cfs. However, discharge from the reservoir is limited by the capacity of the Barber and Careless Creek canals. The design capacity of the Barber canal is 300 cfs. The Careless Creek canal's design capacity is 150 cfs (limited by the drop structure replaced in 1997), but due to water quality problems should be limited to 75 cfs. Therefore, normal releases from the reservoir for both canals should not exceed 375 cfs. Maximum release from the reservoir for both canals should not exceed 450 cfs. Releases exceeding 450 cfs would likely exceed the capacity of the downstream delivery canals causing overtopping and possible failure of the banks as well as damage to the canal structures.

The outlet gates are operated with an electric motor with belts to turn the gates open or close. The electric motor can slide on a mount to operate either gate. The dam operator must make sure the electricity is properly grounded. If the electricity fails, the gates can be manually operated with a hand crank.

The maximum amount which the operating gate can be opened is 60-inches. The maximum opening for the emergency gate is also 60-inches. Openings in excess of these amounts may damage a gate frame, gate stem or the gate pedestal. These openings are measured on the exposed portion of the gate stem between the top of the pedestal and the top of the gate stem.

SAFE DRAWDOWN

Because the stability of Deadman's Basin Dam has not been thoroughly investigated, DNRC recommends that drawdown not exceed one foot per day.

STORAGE DETERMINATION

Reservoir storage is determined by taking slope measurements at the boat ramp located on the south side of the reservoir, approximately one (1) mile southwest of the dam. Measurements are taken from the 0+00 rebar pin located at the upper, east side of the concrete boat ramp. To determine the elevation of the reservoir surface and storage of the reservoir, measure in feet from the rebar pin at the top of the boat ramp to the water surface. The elevation of the reservoir surface and the storage can then be found using the Slope Distance-Elevation-Storage table (Table 1) in Appendix A.

Slope measurements can also taken at Russian Cove. The 0+00 pin is located 112 feet east of a cottonwood tree in the Russian Cove camping area and 28 feet above the eroded bank, and is marked with a white fiberglass fence post. The Slope Distance-Elevation-Storage table (Table 2) for the Russian Cove site is in Appendix A.

If no releases are being made through the low level outlet, the reservoir storage can be determined by measuring the distance in feet from the grate in the tower floor to the water surface, and subtracting this figure from 3,923 feet to determine the reservoir surface elevation. Once the reservoir surface elevation is determined, the reservoir storage is found using the Active Storage In Acre-Feet table (Table 3) in Appendix A.

INFLOW AND OUTFLOW MONITORING

Current flows in the Musselshell River can be found under the Lower Missouri River Basin portion of the following USGS internet site:

http://montana.usgs.gov/mt/nwis/current?type=flow

USGS gage 06120500, Musselshell River at Harlowton, MT: This gage can be used to monitor flows in the river above the supply canal diversion structure.

USGS gage 06123030, Musselshell River above Mud Creek near Shawmut and USGS gage 06126050, Musselshell River near Lavina, MT: These gages can be used to monitor flows in the river below the supply canal diversion structure.

Current inflows into the reservoir and outflows from the reservoir can be found using the SWPB gaging stations. Two are located on the supply canal, one on the Barber canal, and one on the Careless Creek canal.

SWPB Gage 40A 08000: This gage measures the flow of water diverted from the Musselshell River into the supply canal. The gage is located on the left bank of the supply canal 0.1 mi. downstream from the headgate on the Musselshell River. The drainage area above the diversion structure is 1,471 square miles.

SWPB Gage 40A 08080: This gage measures the flow in the supply canal prior to the water entering the reservoir. The gage is located on the right bank of the supply canal about 0.1 mi.

upstream from the reservoir. The drainage area above the gage is 1,504 square miles.

SWPB Gage 40A 10000: This gage measures water released from the reservoir into the Barber Canal. The gage is located on the right bank 220 feet downstream from the headgate structure, and about 0.1 mi. downstream from the dam.

SWPB Gage 40A 09000: This gage measures water released from the reservoir into the Careless Creek Canal. The gage is located on the left bank 300 feet downstream from the headgate structure, and about 0.1 mi. downstream from dam.

Historical inflows into the reservoir and outflows from the reservoir can be found in the SWPB records.

WEATHER MONITORING

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service (NWS).

If severe flooding is anticipated, the NWS Billings Office **(800-240-4596 or 406-652-2314)** should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm.

INTERACTION WITH OTHER DAMS

Except for Fort Peck dam, the only dams located downstream of Deadman's Basin dam are irrigation diversion dams. The safety of these dams is not affected by the operation of Deadman's Basin during either normal or emergency operations. Similarly, the operation of the numerous dams located upstream of the Deadman's Basin supply canal are not a safety concern to the Deadman's Basin dam. Therefore, interaction with other dams is not a concern during the normal operation of Deadman's Basin reservoir.

EMERGENCY

If it appears that the Deadman's Basin Dam is about to breach, or during emergency operations, the dam operator will initiate the **Deadman's Basin Dam Emergency Action Plan.**

INSPECTION AND MONITORING

Annual inspections are conducted by the SWPB. Appendix C includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff, severe rainstorms and windstorms, during high storage periods, and after an earthquake. The water surface through the embankment is monitored by using monitoring wells and "Beck" piezometers.

STRUCTURAL FEATURES INSPECTION

Structural features include the gatehouse and outlet works. The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Outlet Works
    a. Any differential settlement or movement resulting in cracking of the conduit
    b. Erosion of the seals or concrete by cavitation immediately downstream of the gates
    c. Seepage of water into the conduit
    d. Deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
    e. Operation of both gates through a full cycle
    f. Air vent for free, unobstructed operation
    g. Corrosion of any metal
    h. Proper lubrication and cleaning of the pedestals
2. Gate House - Any damage or vandalism
3. Embankment
    a. Erosion gullies in the dam

b. Settlement, bulges, sink holes, cracking, misalignment
c. Displacement or loss of riprap protection
d. Damage from burrowing animals
e. Excessive vegetation, brush, trees
f. Any seepage

RIPRAP INSPECTION

The riprap along the faces of the dam and dike should measure at least 30 (thirty) inches thick. Immediately after the occurrence of high water, the riprap should be inspected and additional riprap added if needed.

EMBANKMENT INSPECTION

The embankment should be inspected for cracking, slumping, or bulging that changes it from the "as-built" condition. The dam crest gets wind blown sand, which builds up humps on the crest and downstream face. This material should be removed from the dam crest so the dam crest height remains at the design elevation.

SEEPAGE

Outlet Channel (right side): Seepage has been observable along the right toe of the outlet channel. The observable flowing water is probably seepage but could be in-bank storage. The observed flows have been estimated to be 2 to 3 gpm. This area extends about 100 feet downstream from the outlet. There are no obvious places to install measuring devices, since this area is inundated when water is released through the outlet.

Outlet Channel (left side): Seepage has been observed exiting along the left toe of the outlet channel. The observable flowing water is probably seepage or could be in-bank storage. The observable flows have been estimated to be 1 to 2 gpm. This area extends about 200 feet downstream from the outlet. There are no obvious places to install measuring devices, since this area is inundated when water is released through the outlet.

Outlet Structure: There is seepage water flowing over the left outlet wing wall, over the center of the outlet head wall, and over the right wing wall. Water exits the face of the dam about a foot above the top of the outlet conduit headwall. The heaviest flows come from the vicinity of the left wing wall. Either more seepage originates to the left of the outlet channel, or that coming from the right side drains out at a lower elevation and is exiting into the channel below the level of the right wing wall. The Department cut back some of the overburden on top of the walls in 1997, installed sand bags to help stabilize the vertical cuts in the overburden, and installed pieces of rain gutter to collect and measure the seepage flows.

There is a hole located adjacent to the right wingwall of the outlet works, which was first observed in 1997. This hole is in the area of a previous hole that was filled with lean concrete by the water users in the early 1980s. Water has been observed in the hole. Seepage water has also been observed flowing from the concrete joints at the downstream end of the right outlet wing wall during past dam safety inspections.

At the normal water surface in the outlet channel, there is a concentrated flow coming from the end of the right outlet wingwall. The flow is estimated to be 1 gpm. There is no practicable location to place a measuring device, since this area is inundated when water is released through the outlet. This area is downstream from the hole located adjacent to the right outlet wingwall.

There also appears to be seepage exiting the end of the left outlet wingwall, but this flow could be the seepage water flowing down the wall from the top, or seepage from behind the wall, or a combination of both. There are no obvious places to install measuring devices, since this area is inundated when water is released through the outlet.

Left Abutment Toe Area: A wet seepage area exists along the downstream toe of the dam in the vicinity of the left abutment groin and left of the outlet channel. This area is in a slight depression and contains standing water. Flowing water has been observed, but not measured. This area has been observed for many years. Six Beck monitoring wells were installed in May 1998 along the edge of the pond area. Data from these wells shows that the water level is this area fluctuates with changes in the reservoir elevation, indicating a connection to the reservoir.

A site inspection was conducted by the Bureau of Reclamation (USBR) from Billings on July 29, 1997. It is their opinion that most of the seepage in the left abutment area and around the outlet structure is reservoir water entering the rock outcropping in the abutments and in the reservoir pool area. That the water passes along the joint systems and permeable zones in the sandstone bedrock beneath the main dam, and exits upward at the ground surface along the toe of the dam and in the low area along the walls of the outlet channel.

Dike Area: There is no apparent seepage through the dike embankment. However, seepage does occur below the dike as evident by a large green area on the slope a few hundred feet downstream from the structure. The seepage is probably reservoir water passing through the jointing and pervious zones within the sandstone beneath the structure.

MONITORING WELLS

Two "Beck" piezometers were installed by the SWPB above the outlet conduit in April, 1997. In 1998, six additional "Beck" piezometers were installed by the SWPB along the left abutment downstream toe of the dam next to the pond area.

During May 1998, the Bureau Of Reclamation (Billings) assisted the Department by drilling 4 drill holes through the crest of the dam into the foundation. The holes are located near the centerline, with two holes located on each side of the outlet. Two piezometers were placed in each hole; one in the foundation and one in the embankment. In October, 1999, four additional holes were drilled, two at the toe of the dam and two at the dike. The 1999 drill holes were funded by a renewable resources grant obtained from the Conservation and Resources Development Division (DNRC). A map showing the location of the monitoring wells is shown as Figure 4. The drill logs are included in Appendix D.

SEEPAGE MONITORING

The seepage and monitoring wells at the dam and dike are observed and monitored by the Lewistown Regional Office, SWPB or dam operator during regular visits; and may be measured by the SWPB during annual inspections. The instruments are generally measured twice per month from May 1 to August 31, and once per month in March, April, September, and October. Measurements may be taken during the winter months (November, December, January, February) depending on weather conditions.

MAINTENANCE

The association is responsible for routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection

ROUTINE MAINTENANCE

To protect the dam and dike and keep them in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator needs to schedule and perform the routine maintenance.

Items that may occasionally need attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt plugging the inlet canal or the outlet channel.* Accumulated debris that could affect the operation of these appurtenances should be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies should be checked immediately. Gullies should be filled, compacted, and seeded. Particular attention should be paid to the abutment contact areas and the downstream faces of dam and dike embankments where four-wheel drive tracks may become a problem.
4. *Rodent damage.* The rodents will be removed or destroyed, and any burrow holes should be filled immediately.
5. *Upstream slope riprap.* The upstream face riprap normally will be observed annually, but may occasionally need repairs because of high water or wave action.
6. *Vegetative cover on downstream slopes.* Good vegetative cover must be maintained, but large brush or any trees should be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and reservoir shall be sprayed at least on an annual basis.
8. *Cleaning spillway and outlet wall tops.* Spillway and outlet wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation or trees.

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of Deadman's Basin Dam and reservoir. During these inspections, items that require maintenance are identified and recorded. Items that may need annual maintenance include the outlet works, gates, riprap, roads, dam and dike embankments, electrical line, and gatehouse. Other routine items that may need immediate attention, such as the need to remove trees or brush, will also be noted.

After the annual inspection, the SWPB sends the association a Dam Inspection Report and a Maintenance Report. The reports identifies items that need maintenance and provides a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items within the time specified.

The dam operator or association members may perform the maintenance tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD-KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include flow measurements, storage volumes, and instrumentation readings. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observation or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

REFERENCES

U.S. Army Corps of Engineers. October 1980. Phase 1 Inspection Report, National Dam Safety Program, Missouri-Musselshell Basin, Deadman's Basin Dams and Reservoir, Wheatland County, Montana, MT-11, MT-522. Prepared for the State of Montana (DNRC) by Hoskins-Western-Sonderegger, Inc. under the U.S. Army Corps of Engineers National Dam Safety Program.

Dalby, Chuck, Hydrologist. September 27, 1988. Deadman's Basin Reservoir Hydrograqphy. Prepared for the State Water Projects Bureau by the Water Management Bureau, DNRC.

Walter Newton. June 1991. Previous dam operator. Personal communications.

Van Mullem, Joseph A., Hydraulic Engineer. August, 1996. Barber Canal Feasibility Report - Phase I - Canal Structures. Prepared for the State of Montana (DNRC) by the Natural Resources Conservation Service.

Van Mullem, Joseph A., Hydraulic Engineer. August, 1996. Barber Canal Feasibility Report - Phase II - Headgate And Canal System. Prepared for the State of Montana (DNRC) by the Natural Resources Conservation Service.

Parish, Lovell, Regional Geologist. July 29, 1997. Travel Report -- Inspection of Seepage and Other Concerns at Deadman's Basin Dam and Dike. Prepared for the State of Montana (DNRC) by the Bureau of Reclamation, Billings Regional Office, Billings, Montana.

Montana DNRC. August, 1998. Project Manual For Deadman's Basin Water Quality Improvement Barber Canal Rehabilitation Project Phase II.

MSE-HKM, Inc. March, 2000. Project Manual For Deadman's Basin Irrigation Project Barber Canal Rehabilitation. Prepared for the State of Montana (DNRC) MSE-HKM, Inc., Billings Montana.

APPENDICES

APPENDIX A

RATING CURVES AND TABLES

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE
DEADMAN'S BASIN RESERVOIR -- BOAT RAMP

The 0+00 point is an iron rebar pin located at the top righthand (southeast) corner of the boat ramp slab adjacent to a marked rock.
Elevations adjusted using a level August 21, 2000.
Storage volumes from January 1994 table.
Chart unreliable below 1+24 where mud covers the boat ramp.

DISTANCE	ELEVATION	STORAGE
0	3921.86	73,970
1	3921.77	73,790
2	3921.68	73,589
3	3921.60	73,436
4	3921.51	73,256
5	3921.42	73,073
6	3921.33	72,888
7	3921.24	72,705
8	3921.15	72,521
9	3921.07	72,360
10	3920.98	72,176
11	3920.89	71,988
12	3920.80	71,800
13	3920.71	71,620
14	3920.63	71,460
15	3920.54	71,280
16	3920.45	71,100
17	3920.36	70,915
18	3920.27	70,727
19	3920.18	70,540
20	3920.10	70,380
21	3920.01	70,200
22	3919.92	69,986
23	3919.83	69,809
24	3919.74	69,644
25	3919.66	69,479
26	3919.57	69,295
27	3919.48	69,112
28	3919.39	68,930
29	3919.30	68,750
30	3919.21	68,570
31	3919.13	68,410
32	3919.04	68,230
33	3918.95	68,050
34	3918.86	67,870
35	3918.77	67,690
36	3918.69	67,530
37	3918.60	67,350
38	3918.51	67,170
39	3918.42	66,990
40	3918.33	66,811
41	3918.24	66,631
42	3918.16	66,472
43	3918.04	66,232
44	3917.93	66,014
45	3917.81	65,777
46	3917.70	65,560
47	3917.58	65,320
48	3917.46	65,080
49	3917.35	64,881
50	3917.23	64,625
51	3917.12	64,408
52	3917.00	64,170
53	3916.89	63,951
54	3916.77	63,715
55	3916.65	63,475
56	3916.54	63,257
57	3916.42	63,020
58	3916.31	62,800
59	3916.19	62,560
60	3916.07	62,320
61	3915.96	62,100
62	3915.84	61,860
63	3915.70	61,581
64	3915.58	61,357
65	3915.47	61,140
66	3915.35	60,907
67	3915.24	60,683
68	3915.12	60,440
69	3915.01	60,220
70	3914.89	59,980
DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

DEADMAN'S BASIN RESERVOIR -- BOAT RAMP

DISTANCE	ELEVATION	STORAGE
71	3914.77	59,740
72	3914.66	59,520
73	3914.54	59,280
74	3914.43	59,060
75	3914.31	58,820
76	3914.19	58,586
77	3914.08	58,362
78	3913.96	58,134
79	3913.85	57,925
80	3913.73	57,697
81	3913.62	57,488
82	3913.50	57,260
83	3913.38	57,032
84	3913.27	56,823
85	3913.15	56,595
86	3913.02	56,348
87	3912.89	56,101
88	3912.77	55,873
89	3912.64	55,626
90	3912.52	55,398
91	3912.39	55,151
92	3912.27	54,923
93	3912.14	54,676
94	3912.02	54,448
95	3911.89	54,201
96	3911.77	53,973
97	3911.64	53,722
98	3911.52	53,490
99	3911.39	53,244
100	3911.17	52,829
101	3911.03	52,560
1+00 CAP	3911.02	52,540
102	3910.90	52,310
103	3910.76	52,044
104	3910.63	51,797
105	3910.49	51,531
106	3910.35	51,267
107	3910.22	51,034
108	3910.08	50,745
109	3909.95	50,505
110	3909.81	50,239
111	3909.68	49,992
112	3909.54	49,725
113	3909.40	49,453
114	3909.27	49,212
115	3909.13	48,947
116	3909.00	48,705
117	3908.86	48,456
118	3908.72	48,208
119	3908.59	47,976
120	3908.45	47,725
121	3908.32	47,492
122	3908.18	47,240
123	3908.04	46,992
124	3907.89	46,722
125	3907.77	46,506
126	3907.64	46,272
127	3907.52	46,056
128	3907.39	45,822
129	3907.27	45,606
130	3907.14	45,372
131	3907.02	45,156
132	3906.89	44,925
133	3906.77	44,712
134	3906.64	44,475
135	3906.52	44,260
136	3906.39	44,032
137	3906.27	43,815
138	3906.14	43,581
139	3906.02	43,365
140	3905.89	43,137
141	3905.77	42,924
142	3905.64	42,687
143	3905.52	42,467
144	3905.39	42,237
145	3905.27	42,024
146	3905.14	41,792
147	3905.02	41,576
148	3904.89	41,337
149	3904.77	41,123
150	3904.64	40,892
151	3904.52	40,676
152	3904.39	40,447
153	3904.27	40,237
154	3904.14	39,948
155	3904.02	39,790
156	3903.89	39,576
157	3903.77	39,378
158	3903.64	39,163
159	3903.52	38,964
160	3903.45	38,848

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

DEADMAN'S BASIN RESERVOIR -- BOAT RAMP

DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE
161	3903.38	38,730			
162	3903.32	38,630			
163	3903.25	38,515			
164	3903.19	38,416			
165	3903.12	38,300			
166	3903.06	38,201			
167	3902.99	38,084			
168	3902.93	37,985			
169	3902.86	37,870			
170	3902.80	37,770			
171	3902.73	37,652			
172	3902.67	37,553			
173	3902.60	37,437			
174	3902.54	37,338			
175	3902.47	37,219			
176	3902.41	37,117			
177	3902.34	37,010			
178	3902.28	36,913			
179	3902.21	36,796			
180	3902.13	36,654			
181	3902.06	36,541			
182	3902.00	36,456			
183	3901.93	36,334			
184	3901.87	36,226			
185	3901.80	36,102			
186	3901.74	36,011			
187	3901.67	35,899			
188	3901.61	35,797			
189	3901.54	35,683			
190	3901.48	35,598			
191	3901.41	35,567			
192	3901.35	35,395			
193	3901.28	35,253			
194	3901.22	35,152			
195	3901.15	35,035			
196	3901.09	34,940			
197	3901.02	34,830			
198	3900.96	34,791			
199	3900.89	34,614			
200	3900.82	34,486			
DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE
DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

Slope pins installed 9/7/2000 and elevations determined using a level 9/14/2000.

The 0+00 pin is located 112 feet east of a cottonwood tree in the Russion Cove camping area and 28 feet above the eroded bank.

A white fiberglass fence post was installed at the 0+00 point to serve as a back sight.

The top of the intake trash rack (elevation 3887.4 feet) is at 5+92.5 slope distance.

Storage volumes from January 1994 table.

DISTANCE	ELEVATION	STORAGE
0+00 CAP	3929.21	92,941
1	3929.17	92,827
2	3929.11	92,657
3	3929.05	92,487
4	3928.99	92,317
5	3928.93	92,147
6	3928.87	91,977
7	3928.81	91,807
8	3928.75	91,637
9	3928.69	91,466
10	3928.49	90,899
11	3928.35	90,503
12	3928.20	90,077
13	3928.05	89,652
14	3927.91	89,255
15	3927.76	88,830
16	3927.62	88,433
17	3927.47	88,008
18	3927.32	87,582
19	3927.18	87,185
20	3927.03	86,760
21	3926.89	86,363
22	3926.74	85,938
23	3926.59	85,513
24	3926.45	85,116
25	3926.30	84,691
26	3926.16	84,294
27	3926.01	83,868
28	3924.20	78,737
29	3922.46	75,191
30	3922.18	74,617
31	3921.89	74,030
32	3921.60	73,436
33	3921.32	72,868
34	3921.25	72,725
35	3921.08	72,380
36	3920.90	72,009
37	3920.72	71,640
38	3920.55	71,300
39	3920.37	70,936
40	3920.20	70,580
41	3920.04	70,260
42	3919.91	69,962
43	3919.79	69,744
44	3919.66	69,479
45	3919.54	69,234
46	3919.41	68,970
47	3919.29	68,730
48	3919.17	68,490
49	3919.04	68,230
0+50 CAP	3919.02	68,190
50	3918.96	68,070
51	3918.92	67,990
52	3918.90	67,950
53	3918.87	67,890
54	3918.85	67,850
55	3918.82	67,790
56	3918.80	67,750
57	3918.77	67,690
58	3918.75	67,650
59	3918.73	67,610
60	3918.70	67,550
61	3918.68	67,510
62	3918.56	67,270
63	3918.43	67,010
64	3918.31	66,771
65	3918.19	66,531
66	3918.06	66,272
67	3917.94	66,033
68	3917.82	65,797
69	3917.69	65,540
70	3917.57	65,300
71	3917.45	65,060
72	3917.33	64,850
73	3917.26	64,700
74	3917.17	64,506
75	3917.09	64,348
76	3917.00	64,170
DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE
77	3916.91	63,991
78	3916.83	63,834
79	3916.74	63,655
80	3916.65	63,475
81	3916.57	63,316
82	3916.48	63,139
83	3916.40	62,980
84	3916.31	62,800
85	3916.22	62,620
86	3916.14	62,460
87	3916.05	62,280
88	3916.00	62,180
89	3915.94	62,060
90	3915.88	61,940
91	3915.82	61,820
92	3915.76	61,701
93	3915.70	61,581
94	3915.64	61,468
95	3915.58	61,357
96	3915.52	61,240
97	3915.46	61,120
98	3915.39	60,984
99	3915.33	60,868
1+00 CAP	3915.33	60,868
100	3915.22	60,641
101	3915.16	60,520
102	3915.09	60,380
103	3915.03	60,260
104	3914.96	60,120
105	3914.89	59,980
106	3914.83	59,860
107	3914.76	59,720
108	3914.70	59,600
109	3914.63	59,460
110	3914.57	59,340
111	3914.50	59,200
112	3914.44	59,080
113	3914.37	58,940
114	3914.30	58,800
115	3914.24	58,680
116	3914.17	58,540
117	3914.10	58,400
118	3914.03	58,267
119	3913.96	58,134
120	3913.90	58,020
121	3913.83	57,887
122	3913.76	57,754
123	3913.69	57,621
124	3913.62	57,488
125	3913.56	57,374
126	3913.49	57,241
127	3913.42	57,108
128	3913.35	56,975
129	3913.28	56,842
130	3913.21	56,709
131	3913.15	56,595
132	3913.08	56,462
133	3913.01	56,329
134	3912.94	56,196
135	3912.93	56,177
136	3912.88	56,082
137	3912.84	56,006
138	3912.79	55,911
139	3912.75	55,835
140	3912.70	55,740
141	3912.66	55,664
142	3912.61	55,569
143	3912.57	55,493
144	3912.52	55,398
145	3912.48	55,322
146	3912.43	55,227
147	3912.39	55,151
148	3912.35	55,075
149	3912.30	54,980
150	3912.26	54,904
151	3912.23	54,847
1+50 CAP	3912.22	54,828
152	3912.19	54,771
153	3912.16	54,714
154	3912.12	54,638
155	3912.09	54,581
156	3912.05	54,505
157	3912.01	54,429
158	3911.98	54,372
159	3911.94	54,296
160	3911.91	54,239
161	3911.87	54,163
162	3911.83	54,087
163	3911.80	54,030
164	3911.76	53,954
165	3911.73	53,896
166	3911.69	53,818

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE
167	3911.65	53,741
168	3911.58	53,606
169	3911.52	53,490
170	3911.46	53,375
171	3911.40	53,263
172	3911.34	53,151
173	3911.28	53,038
174	3911.22	52,924
175	3911.16	52,810
176	3911.10	52,694
177	3911.04	52,579
178	3910.98	52,464
179	3910.92	52,348
180	3910.86	52,234
181	3910.80	52,120
182	3910.74	52,006
183	3910.68	51,892
184	3910.62	51,778
185	3910.56	51,664
186	3910.52	51,588
187	3910.47	51,493
188	3910.43	51,417
189	3910.38	51,322
190	3910.34	51,249
191	3910.30	51,177
192	3910.25	51,087
193	3910.21	51,012
194	3910.16	50,906
195	3910.12	50,821
196	3910.08	50,745
197	3910.03	50,654
198	3909.99	50,581
199	3909.94	50,486
200	3909.90	50,410
2+00 CAP	3909.88	50,372
201	3909.88	50,372
202	3909.82	50,258
203	3909.77	50,163
204	3909.71	50,049
205	3909.66	49,954
206	3909.60	49,840
207	3909.55	49,745
208	3909.49	49,627
209	3909.44	49,529
210	3909.39	49,434
211	3909.33	49,324
212	3909.28	49,231
213	3909.22	49,117
214	3909.17	49,022
215	3909.11	48,909
216	3909.01	48,723
217	3908.96	48,634
218	3908.91	48,545
219	3908.85	48,438
220	3908.80	48,349
221	3908.75	48,260
222	3908.70	48,173
223	3908.64	48,068
224	3908.59	47,976
225	3908.54	47,884
226	3908.48	47,777
227	3908.43	47,690
228	3908.38	47,602
229	3908.32	47,492
230	3908.27	47,400
231	3908.22	47,310
232	3908.18	47,240
233	3908.12	47,134
234	3908.05	47,010
235	3907.99	46,902
236	3907.92	46,776
237	3907.86	46,668
238	3907.80	46,560
239	3907.73	46,434
240	3907.67	46,326
241	3907.60	46,200
242	3907.54	46,092
243	3907.47	45,966
244	3907.41	45,858
245	3907.35	45,750
246	3907.28	45,624
247	3907.22	45,516
248	3907.15	45,390
249	3907.09	45,282
2+50 CAP	3907.06	45,228
250	3907.02	45,156
251	3907.01	45,138
252	3906.98	45,085
253	3906.95	45,032
254	3906.92	44,978
255	3906.88	44,907
256	3906.85	44,854
DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)
DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE
257	3906.82	44,801	302	3904.47	40,586
258	3906.79	44,748	303	3904.43	40,517
259	3906.76	44,695	304	3904.38	40,429
260	3906.72	44,624	305	3904.34	40,359
261	3906.69	44,568	306	3904.29	40,272
262	3906.66	44,512	307	3904.25	40,200
263	3906.63	44,457	308	3904.20	40,080
264	3906.59	44,383	309	3904.16	39,984
265	3906.56	44,330	310	3904.12	39,924
266	3906.53	44,277	311	3904.07	39,864
267	3906.48	44,190	312	3904.03	39,807
268	3906.44	44,120	313	3903.98	39,724
269	3906.40	44,050	314	3903.94	39,658
270	3906.36	43,977	315	3903.89	39,576
271	3906.32	43,905	316	3903.87	39,543
272	3906.29	43,851	317	3903.81	39,444
273	3906.25	43,779	318	3903.76	39,361
274	3906.21	43,707	319	3903.70	39,262
275	3906.17	43,635	320	3903.65	39,180
276	3906.13	43,563	321	3903.59	39,081
277	3906.09	43,491	322	3903.53	38,981
278	3906.06	43,437	323	3903.48	38,898
279	3906.02	43,365	324	3903.42	38,797
280	3905.98	43,294	325	3903.37	38,713
281	3905.94	43,224	326	3903.31	38,614
282	3905.86	43,084	327	3903.26	38,531
283	3905.79	42,960	328	3903.20	38,432
284	3905.71	42,816	329	3903.14	38,333
285	3905.64	42,687	330	3903.09	38,251
286	3905.57	42,556	331	3903.03	38,151
287	3905.49	42,414	332	3902.98	38,067
288	3905.42	42,290	333	3902.92	37,969
289	3905.35	42,166	334	3902.87	37,887
290	3905.27	42,024	335	3902.83	37,821
291	3905.20	41,900	336	3902.78	37,736
292	3905.13	41,774	337	3902.74	37,668
293	3905.05	41,630	338	3902.69	37,586
294	3904.98	41,502	339	3902.65	37,520
295	3904.91	41,374	340	3902.60	37,437
296	3904.83	41,229	341	3902.56	37,372
297	3904.76	41,105	342	3902.51	37,287
298	3904.69	40,982	343	3902.47	37,219
3+00 CAP	3904.66	40,928	344	3902.42	37,134
299	3904.61	40,838	345	3902.38	37,071
300	3904.56	40,748	346	3902.33	36,995
301	3904.52	40,676	347	3902.29	36,929
DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE
348	3902.24	36,847
349	3902.20	36,778
3+50 CAP	3902.18	36,744
350	3902.15	36,690
351	3902.11	36,618
352	3902.06	36,541
353	3902.01	36,469
354	3901.97	36,406
355	3901.92	36,316
356	3901.88	36,244
357	3901.83	36,154
358	3901.78	36,072
359	3901.74	36,011
360	3901.69	35,933
361	3901.65	35,865
362	3901.60	35,780
363	3901.55	35,700
364	3901.51	35,635
365	3901.42	35,571
366	3901.38	35,481
367	3901.33	35,338
368	3901.28	35,253
369	3901.24	35,186
370	3901.19	35,102
371	3901.15	35,035
372	3901.10	34,956
373	3901.06	34,893
374	3901.01	34,823
375	3900.96	34,791
376	3900.92	34,699
377	3900.87	34,569
378	3900.83	34,502
379	3900.78	34,423
380	3900.74	34,361
381	3900.69	34,280
382	3900.64	34,195
383	3900.60	34,129
384	3900.54	34,032
385	3900.48	33,931
386	3900.42	33,831
387	3900.36	33,730
388	3900.30	33,630
389	3900.24	33,530
390	3900.18	33,430
391	3900.12	33,330
392	3900.06	33,230
393	3900.00	33,130
394	3899.94	33,031
395	3899.88	32,933
396	3899.82	32,834
397	3899.77	32,752
398	3899.71	32,683
399	3899.65	32,581
4+00 CAP	3899.63	32,541
400	3899.58	32,441
401	3899.52	32,342
402	3899.45	32,228
403	3899.39	32,129
404	3899.33	32,031
405	3899.27	31,933
406	3899.21	31,834
407	3899.14	31,719
408	3899.08	31,621
409	3899.02	31,522
410	3898.96	31,429
411	3898.90	31,337
412	3898.83	31,230
413	3898.77	31,138
414	3898.71	31,046
415	3898.65	30,955
416	3898.59	30,862
417	3898.52	30,755
418	3898.46	30,663
419	3898.40	30,571
420	3898.34	30,480
421	3898.28	30,388
422	3898.22	30,296
423	3898.16	30,205
424	3898.10	30,113
425	3898.04	30,021
426	3897.98	29,929
427	3897.92	29,838
428	3897.86	29,746
429	3897.80	29,655
430	3897.74	29,564
431	3897.68	29,472
432	3897.62	29,381
433	3897.56	29,290
434	3897.50	29,199
435	3897.44	29,108
436	3897.41	29,063
437	3897.36	28,987
DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)
DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE
438	3897.31	28,911
439	3897.27	28,850
440	3897.22	28,774
441	3897.17	28,698
442	3897.12	28,622
443	3897.07	28,546
444	3897.02	28,470
445	3896.98	28,409
446	3896.93	28,333
447	3896.88	28,256
448	3896.83	28,180
449	3896.78	28,103
450	3896.71	27,996
4+50 CAP	3896.69	27,965
451	3896.65	27,904
452	3896.59	27,812
453	3896.53	27,720
454	3896.47	27,629
455	3896.40	27,522
456	3896.34	27,430
457	3896.28	27,338
458	3896.22	27,246
459	3896.16	27,155
460	3896.10	27,063
461	3896.04	26,971
462	3895.97	26,865
463	3895.91	26,773
464	3895.85	26,682
465	3895.79	26,590
466	3895.73	26,499
467	3895.67	26,407
468	3895.60	26,300
469	3895.53	26,195
470	3895.46	26,089
471	3895.39	25,982
472	3895.32	25,876
473	3895.26	25,785
474	3895.19	25,678
475	3895.12	25,572
476	3895.05	25,466
477	3894.98	25,360
478	3894.91	25,254
479	3894.85	25,163
480	3894.78	25,057
481	3894.71	24,952
482	3894.64	24,846
483	3894.57	24,740
484	3894.50	24,635
485	3894.43	24,529
486	3894.37	24,438
487	3894.33	24,378
488	3894.26	24,272
489	3894.19	24,168
490	3894.12	24,065
491	3894.05	23,963
492	3893.98	23,860
493	3893.91	23,758
494	3893.84	23,658
495	3893.77	23,562
496	3893.70	23,465
497	3893.63	23,369
498	3893.56	23,272
499	3893.49	23,176
500	3893.40	23,052
5+00 CAP	3893.38	23,024
501	3893.34	22,969
502	3893.27	22,872
503	3893.21	22,790
504	3893.15	22,707
505	3893.08	22,610
506	3893.02	22,528
507	3892.95	22,430
508	3892.89	22,346
509	3892.83	22,262
510	3892.76	22,164
511	3892.70	22,080
512	3892.64	21,996
513	3892.57	21,898
514	3892.51	21,814
515	3892.45	21,730
516	3892.38	21,632
517	3892.32	21,548
518	3892.25	21,450
519	3892.17	21,338
520	3892.06	21,184
521	3891.96	21,044
522	3891.86	20,906
523	3891.76	20,768
524	3891.65	20,616
525	3891.55	20,478
526	3891.45	20,341
527	3891.43	20,313
DISTANCE	ELEVATION	STORAGE

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)
DEADMAN'S BASIN RESERVOIR -- RUSSIAN COVE

DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE
528	3891.40	20,272	573	3889.35	17,449
529	3891.36	20,217	574	3889.28	17,353
530	3891.33	20,175	575	3889.21	17,257
531	3891.29	20,120	576	3889.14	17,161
532	3891.25	20,065	577	3889.08	17,079
533	3891.22	20,023	578	3889.01	16,984
534	3891.18	19,968	579	3888.94	16,896
535	3891.15	19,927	580	3888.87	16,810
536	3891.11	19,871	581	3888.80	16,724
537	3891.07	19,816	582	3888.74	16,650
538	3891.04	19,774	583	3888.67	16,564
539	3891.00	19,721	584	3888.51	16,367
540	3890.95	19,655	585	3888.34	16,158
541	3890.90	19,595	586	3888.18	15,961
542	3890.85	19,524	587	3888.02	15,764
543	3890.81	19,467	588	3887.91	15,628
544	3890.76	19,396	589	3887.79	15,480
545	3890.71	19,324	590	3887.68	15,343
546	3890.66	19,253	591	3887.56	15,194
547	3890.62	19,196	592	3887.45	15,057
548	3890.57	19,126	593	3887.43	15,033
549	3890.52	19,057	TOP TRASH RACK	3887.40	14,996
5+50 CAP	3890.52	19,057	594	3887.37	14,958
550	3890.47	18,988	595	3887.32	14,896
551	3890.43	18,933	596	3887.27	14,834
552	3890.39	18,878	597	3887.21	14,760
553	3890.35	18,823	598	3887.16	14,698
554	3890.32	18,781	599	3887.10	14,623
555	3890.28	18,726	6+00 CAP	3887.08	14,599
556	3890.24	18,671	600	3886.94	14,426
557	3890.20	18,616	601	3886.78	14,229
558	3890.17	18,574	602	3886.63	14,044
559	3890.13	18,519	603	3886.59	13,995
560	3890.08	18,450	604	3886.56	13,959
561	3890.03	18,381	605	3886.52	13,909
562	3889.98	18,312	606	3886.48	13,860
563	3889.92	18,230	607	3886.44	13,811
564	3889.87	18,161	608	3886.40	13,762
565	3889.82	18,093			
566	3889.77	18,024			
567	3889.72	17,956			
568	3889.67	17,887			
569	3889.62	17,819			
570	3889.57	17,750			
571	3889.49	17,641			
572	3889.42	17,545			
DISTANCE	ELEVATION	STORAGE	DISTANCE	ELEVATION	STORAGE

TABLE 3. ACTIVE STORAGE IN ACRE-FEET

DEADMAN'S BASIN RESERVOIR

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
3880									7,458	7,564
3881	7,670	7,775	7,880	7,985	8,090	8,195	8,300	8,405	8,510	8,615
3882	8,720	8,825	8,930	9,035	9,140	9,245	9,350	9,455	9,560	9,665
3883	9,770	9,876	9,981	10,087	10,193	10,299	10,406	10,511	10,617	10,724
3884	10,836	10,951	11,072	11,193	11,314	11,434	11,555	11,676	11,798	11,919
3885	12,040	12,163	12,286	12,409	12,531	12,654	12,778	12,901	13,024	13,146
3886	13,270	13,393	13,516	13,639	13,762	13,885	14,008	14,131	14,254	14,377
3887	14,500	14,623	14,747	14,872	14,995	15,119	15,244	15,368	15,492	15,616
3888	15,740	15,863	15,986	16,109	16,232	16,355	16,477	16,601	16,724	16,847
3889	16,971	17,106	17,243	17,380	17,517	17,654	17,792	17,928	18,065	18,202
3890	18,340	18,478	18,616	18,754	18,892	19,030	19,168	19,310	19,453	19,595
3891	19,721	19,857	19,996	20,134	20,272	20,410	20,547	20,685	20,823	20,961
3892	21,100	21,240	21,380	21,520	21,660	21,800	21,940	22,080	22,220	22,360
3893	22,500	22,638	22,776	22,914	23,052	23,189	23,327	23,465	23,603	23,743
3894	23,889	24,036	24,183	24,332	24,483	24,635	24,786	24,937	25,088	25,238
3895	25,390	25,542	25,694	25,846	25,998	26,149	26,300	26,454	26,606	26,758
3896	26,910	27,063	27,216	27,369	27,522	27,675	27,828	27,981	28,134	28,287
3897	28,439	28,592	28,744	28,896	29,048	29,199	29,351	29,503	29,655	29,807
3898	29,960	30,113	30,266	30,419	30,571	30,724	30,877	31,031	31,184	31,337
3899	31,490	31,653	31,818	31,982	32,146	32,309	32,481	32,672	32,801	32,966
3900	33,130	33,297	33,463	33,630	33,797	33,965	34,129	34,297	34,454	34,642
3901	34,817	34,956	35,119	35,287	35,538	35,619	35,780	35,950	36,102	36,280
3902	36,456	36,602	36,778	36,945	37,101	37,270	37,437	37,602	37,770	37,936
3903	38,100	38,268	38,432	38,597	38,764	38,931	39,097	39,262	39,427	39,592
3904	39,757	39,900	40,080	40,289	40,464	40,640	40,820	40,999	41,176	41,355
3905	41,539	41,720	41,900	42,077	42,254	42,431	42,612	42,798	42,978	43,154
3906	43,329	43,509	43,689	43,869	44,050	44,225	44,401	44,586	44,765	44,943
3907	45,121	45,300	45,480	45,660	45,840	46,020	46,200	46,380	46,560	46,740
3908	46,920	47,099	47,275	47,455	47,638	47,811	47,994	48,173	48,349	48,527
3909	48,705	48,890	49,079	49,269	49,453	49,646	49,840	50,030	50,220	50,410
3910	50,600	50,781	50,991	51,177	51,360	51,550	51,740	51,930	52,120	52,310

TABLE 3. ACTIVE STORAGE IN ACRE-FEET (continued)

DEADMAN'S BASIN RESERVOIR

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
3911	52,502	52,694	52,886	53,076	53,263	53,451	53,644	53,838	54,030	54,220
3912	54,410	54,600	54,790	54,980	55,170	55,360	55,550	55,740	55,930	56,120
3913	56,310	56,500	56,690	56,880	57,070	57,260	57,450	57,640	57,830	58,020
3914	58,210	58,400	58,600	58,800	59,000	59,200	59,400	59,600	59,800	60,000
3915	60,200	60,400	60,600	60,809	61,004	61,200	61,394	61,581	61,781	61,980
3916	62,180	62,380	62,580	62,780	62,980	63,178	63,376	63,575	63,775	63,971
3917	64,170	64,368	64,566	64,803	64,960	65,160	65,360	65,560	65,758	65,955
3918	66,152	66,352	66,551	66,751	66,950	67,150	67,350	67,550	67,750	67,950
3919	68,150	68,350	68,550	68,750	68,950	69,152	69,356	69,561	69,760	69,938
3920	70,180	70,380	70,580	70,790	70,999	71,200	71,400	71,600	71,800	72,009
3921	72,218	72,420	72,623	72,827	73,032	73,238	73,436	73,635	73,850	74,050
3922	74,251	74,453	74,658	74,863	75,068	75,272	75,477	75,687	75,887	76,087
3923	76,297	76,497	76,707	76,907	77,107	77,317	77,517	77,727	77,927	78,127
3924	78,337	78,537	78,737	78,937	79,137	79,347	79,547	79,757	79,967	80,167
3925	80,367									
3926	83,297									
3927	86,228									
3928	89,158									
3929	92,088									
3930	95,018									
3931	97,949									
3931.7	100,000									

NOTES: Storage figures do not include dead storage.
Dead Storage (below elevation 3872.0 feet) -- 4,600 acre feet.
Dalby Report (9/27/1988) -- found dead storage to be 3,750 acre feet

Normal Full Pool Elevation	3,921.0 feet	72,218 acre-feet
Grate Elevation In Tower	3,923.0 feet	76,297 acre-feet
Minimum Dam Crest	3,931.7 feet	100,000 acre-feet

Storage volumes based on 1935 original hand surveys of the reservoir.

APPENDIX B

INSPECTION REPORT

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM
DATE INSPECTED

INVENTORY NO. ______________
HAZARD CATEGORY __________
TYPE OF DAM ________________
YEAR BUILT __________________

OWNER __________________________
OPERATOR _____________________
STREAM __________________________
DRAINAGE AREA _________________

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_________	__________
At spillway crest	_________	__________
At min. dam crest elevation	_________	__________

ITEM	YES	NO	REMARKS

1. EMBANKMENT

A. Crest -- Height= Length= Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS

1. **EMBANKMENT** (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

ITEM	YES	NO	REMARKS

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

B. Conduit -- Type = Size =

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating: b. Type: Operating:	Emergency: Emergency:		
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Condition of gate seals?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? _____ wet?			
(11) Any seepage in the tower?			
(12) Condition of the tower?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Condition of the gatehouse?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or backcutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS

4. SPILLWAY (continued)

4. B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

This dam was inspected by:

Additional comments and recommendations.

APPENDIX C

DISTRIBUTION LIST

O&M DISTRUBUTION LIST

DEADMAN'S BASIN DAM

	Number Of Copies
1. State Water Projects Bureau	7
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Richard Haxton – Director District 5	
6. Dam Operator	2
Terri Hice	
Gate House	
7. State Library	4
8. Extra	2
Total	24

APPENDIX D

MONITORING WELL LOGS

(NOTE: The soil profile logs and details as to how the wells were constructed for the drill holes 5, 6, 7, and 8 have not been prepared as of this printing. The soil profile and well completion logs will be added in the future when they are prepared.)

PROJECT: Deadmans Basin

LOCATION: DH-1 Crest Sta 2+75

BORING DATE: 5/16/98 **DATUM:** 3933.0 **DIP:**

Drill Hole No. 1

Page 1 OF 2

LOGGED: Michele Lemieux

BORING METHOD: Hollow Stem Auger

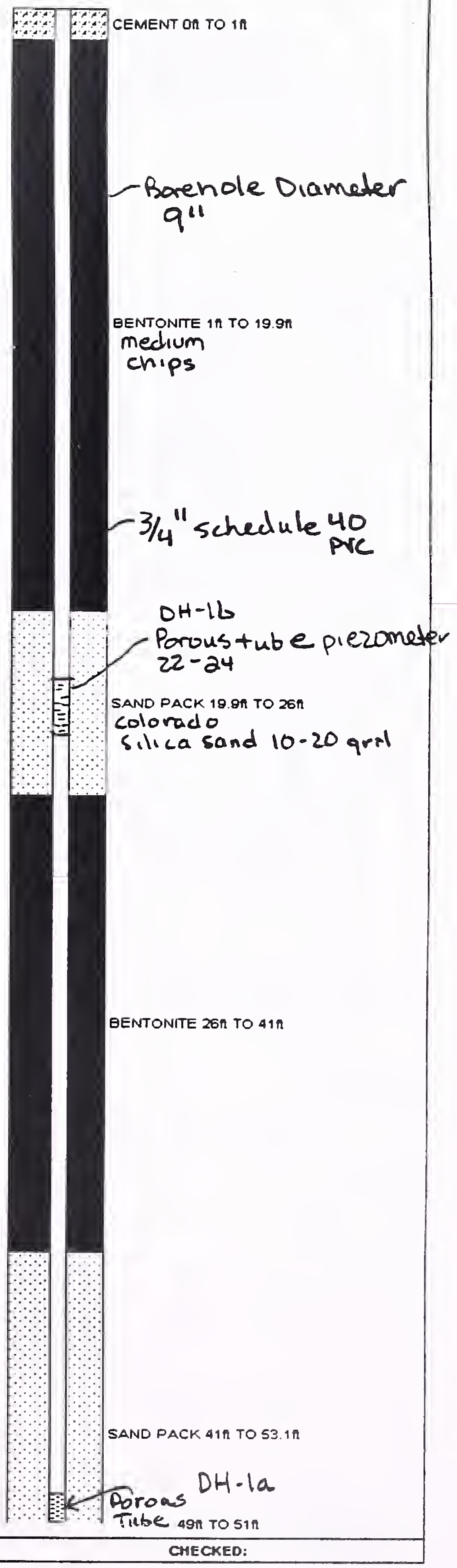
SOIL PROFILE

DESCRIPTION	DEPTH B.G.S. (ft)
3933.0	
Road Material - Gravelly clayey sand	0
Embankment Fill - lean sandy clay (CL), very stiff to hard; slightly moist; dark brown; becoming increasingly stiff with depth. Occasional thin fine sandy clay lenses. At 23.9', a thin (0.2 feet), saturated sandy gravelly clay was encountered.	1.75
Increase in subrounded gravel; max size 1/4 inch; moist (not saturated); increase in appearance of organic material	24.2
Foundation/Embankment contact - organic fat sandy clay (OH); moist; very soft	28.9
Increase in sand (20-30%)	32.8
Clayey sand (SC); heaving saturated fine sands, no gravel or organic material, low to medium plasticity fines	34.6
Decomposed Quartz sandstone - wet, loose, fine sand; some organics; cobbles and sandstone fragments (weathering zone); low plasticity fines.	38.5
Sandy clay; orange brown, horizontally laminated; dry, soft; 1" rock frags	44.9
Decomposed Quartz sandstone; mostly saturated rock fragments (up to 6") with significant clay (40%), iron oxide stains,	47.1
Continued on next page	49.7

SAMPLES / SOIL TESTS

ID	TYPE	RECOVERY (%)	"N" VALUE	PI	LL	% G	% S	% F
	SS	96	10					
	SS	100	11					
	SS	93	12	23	38	1	34	65
	SS	73	9					
	SS	106	10					
	SS	93	5	33	50	0	18	82
	SS	0	1					
	SS	60	45					

CONSTRUCTION DIAGRAM



DRAWN:

CHECKED:

PROJECT: Deadmens Basin

LOCATION: DH-1 Crest Sta 2+75

Drill Hole No. 1

Page 2 OF 2

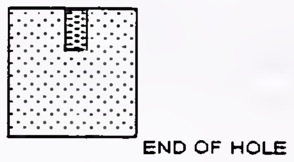
BORING DATE: 5/18/98 DATUM: 3933.0 DIP: LOGGED: Michele Lemieux

DEPTH SCALE METRES	DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	SAMPLES ID	TYPE	RECOVERY (%)	"N" VALUE
	50	Hollow Stem Auger	Increasing competance; fractured water bearing zone 51.0 - 51.5'	░					
16	52		lean moist clay containing 3-4" sandstone fragments and fine sand	▨	51.5				
	54		END OF HOLE @ 53.10ft		53.10				
17	56								
	58								
18	60								
19	62								
	64								
20	66								
	68								
21	70								
22	72								
	74								
23	76								
	78								
24	80								
25	82								
	84								
26	86								
27	88								
	90								
28	92								
	94								
29	96								
30	98								
	100								

- was able to use Hollow stem auger entire hole with only moderate difficulty
- Bedrock @ 38.6' - not very competent SPT taken for relative use only
- TD voluntary

CONSTRUCTION DIAGRAM

DH-1



DRAWN: CHECKED:

PROJECT: **Deadmans Basin**

LOCATION: **DH-2 Crest Sta 4+35**

BORING DATE: **05/16/98**

Drill Hole No. 2

Page 1 OF 2

DATUM: **3933.0 feet** Ground Surface

LOGGED: **Michele Lemieux**

BORING METHOD: Hollow Stem Auger to 44.7 - Wireline to TD

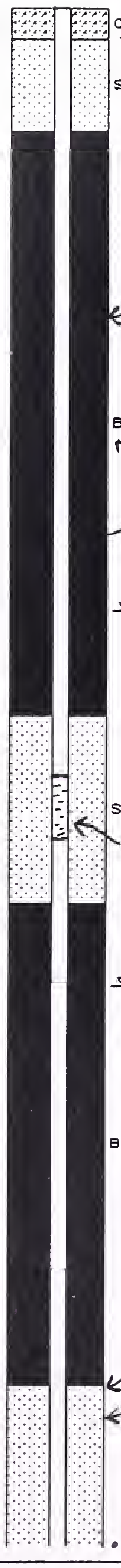
SOIL PROFILE			SAMPLES				SOIL TESTS				
DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	ID	TYPE	RECOVERY (%)	"N" VALUE	PI	LL	% G	% S	% F
3933.0											
Road Material - clayey sand with gravel	▩	0									
Embankment Fill - Lean sandy clay (CL) - 10% fine sand, medium brown, some decomposed shale fragments, moist, stiff. Some thin sand layers	▨	1.2	1	SS	87	14					
			2	ss	73	11					
Embankment Fill - Gravelly Sand (SP); 15% fines, max 1/4"; moist; loose	░	13.5	3	ss	93	7					
Embankment Fill - Lean Sandy Clay; 30% sand; 4% gravel; moist, medium stiff, some sand and clay nodules	▨	15.5	4	ss	100	10	21	36	4	31	65
			5	sh	50						
			6	sh	100						
Foundation/Embankment Contact - organic lean sandy clay (OL); moist, very stiff; roots present; 40% fine sand	☰	29.3	7	SS	100	19	24	36	0	41	59
Bedrock - Decomposed quartz sandstone; Water encountered at top of bedrock (31.7'); poorly consolidated; some hard nodules; mostly fined grained; Competency increasing with depth	⋯	31.7									
Clay lense	▨	40									
Bedrock - Quartz Sandstone; hard, horizontal fractures; At 42.8 - 44.7 - poorly consolidated layer; occasional iron banding; fracture zones increase with depth	⋯	40.5		GR			RQD=67.9				

Continued on next page

Completion Diagram

Nested Piezometers
DH-2b - Shallow
DH-2a - Deep

DH-2



Portland CEMENT 0ft TO 1ft Type II

SAND 1ft TO 4ft 10-20 Grit Colorado Silica Sand

Borehole Diameter, 9" 0 to 44.7'

BENTONITE 4ft TO 22.9ft medium chips

3/4" Sch 40 PVC

▼ 19.5ft, 5/15/98

SAND 22.9ft TO 29ft

Porous tube 29' to 27' DH2b

▽ 31.7ft, 5/14/98 water first encountered

BENTONITE 29ft TO 44.7ft

Begin Coring

Borehole Diameter 3.9" 44.7' to 70'

• loss of circulation

CHECKED:

PROJECT: Deadmans Basin

LOCATION: DH-2 Crest Sta 4+35

BORING DATE: 05/15/98

DATUM: 3933.0 feet

Drill Hole No. 2

LOGGED: Michele Lemieux

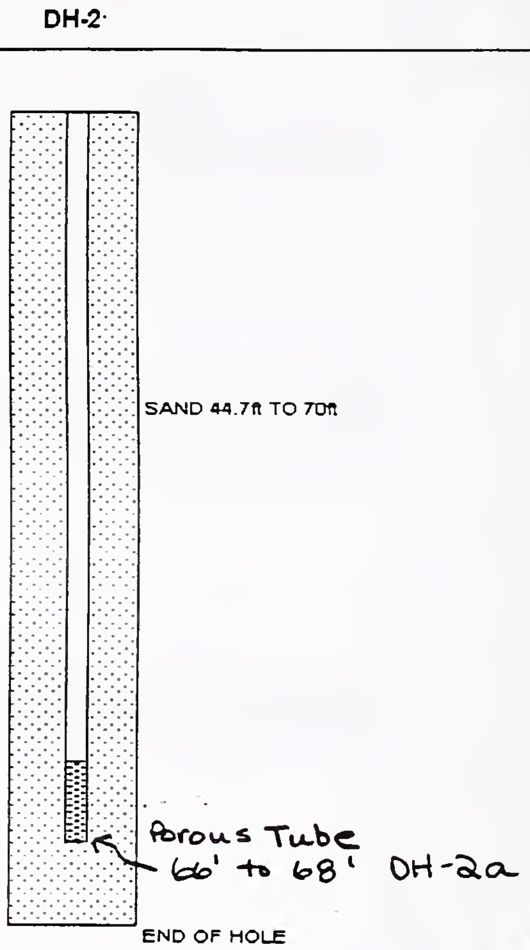
DEPTH SCALE
METRES: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30
FEET: 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100

BORING METHOD: Hollow Stem Auger to 44.7 - Wireline to TD

SOIL PROFILE – DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	SAMPLES – ID	TYPE	RECOVERY (%)	"N" VALUE	
Bedrock - Quartz Sandstone; well indurated but very fractured from 50.5 to 51.8; 20 to 30 degree dip in fractures; 64.4 to 65.4 RQD; some thin laminations, iron oxide stains on fractures	░	50.5		GR			K = 4.7 ft/day RQD = 65.4 RQD = 64.4
Clay (CH): Likely from decomposed shale:	▨	69.1					
END OF HOLE @ 70.00ft		70.00					

- hole began to heave at 39.7'
- Packer Test
  ran from 50.8' to 60.4'
  (Test interval)
  5 min Test
  ave flowrate = 33.5 GPM
  $K = .024 \frac{Gal}{min \cdot ft^2}$
  = 4.7 ft/day
  ~ very pervious
- unable to core past Decomposed shale at 69-70'

Completion Diagram



- Rig Type CME 85
- core bit HQ3
  2.385" ID
- SPT SS sampler
  1.5" ID
- Auger
  4.5" ID
  Bit - 9" OD
- Drill Rod length - 5'
  Hollow stem auger
- Drill Rod length - 10'
  wireline
- Continous split spoon sampler - 3" ID
- Shelby Type acrylic liner - 3" ID
- SPT hammer - calibrated auto trip

CHECKED:

Drill Hole No. 3

PROJECT: Deadmans Basin
LOCATION: Crest sta 6+55
BORING DATE: 05/16/98
DATUM: 3933
DIP:
LOGGED: Jim Robinson

BORING METHOD: Hollow Stem Auger

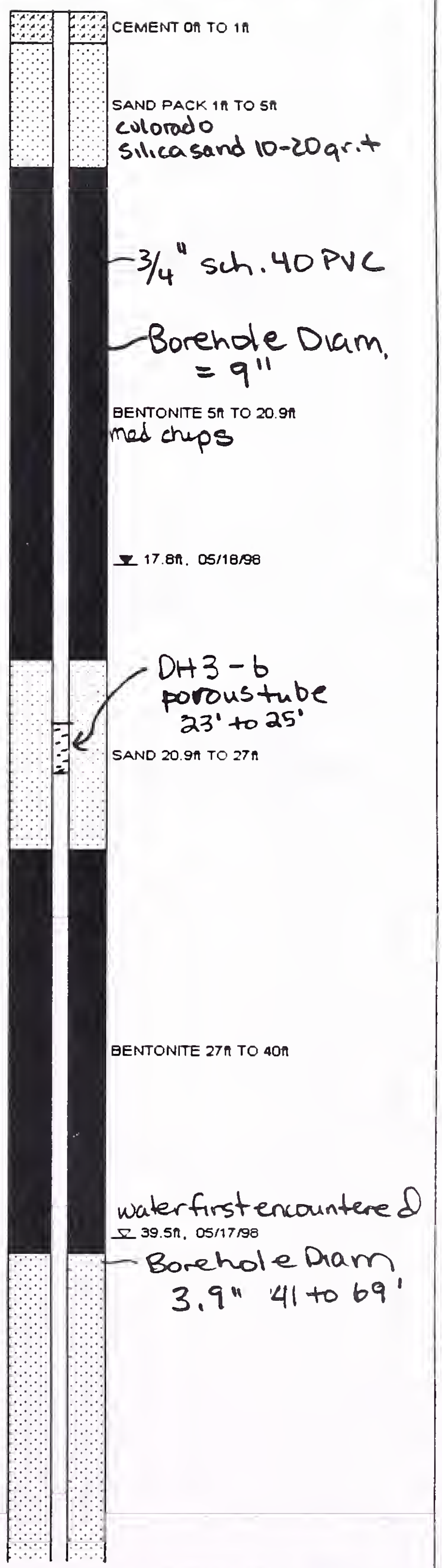
DESCRIPTION	DEPTH B.G.S. (ft)	ID	TYPE	RECOVERY (%)	"N" VALUE	PI	LL	% G	% S	% F
3933										
Road Material - Gravelly sand, loose, dry	0									
Embankment Fill - lean sandy clay (CL); medium brown, moist, stiff	1.7		SS	106	12	31	46	0	14	86
			SS	93	10					
			SS	87	14					
			SS	100	8					
			SH	100		24	56	2	38	60
intermitant wet and soft segments; sandstone fragments up to 3"	24.5		SS	113	10					
	27									
Foundation/embankment contact: Lean organic sandy clay (OL-CL); soft; roots and partially decomposed grass; moist except for wet zone at 32'-33';	27.5		SS	113	7					
			SS	100	9					
Foundation - lean sandy clay	37.0									
	38.8									
Bedrock - Decomposed sandstone; water encountered; thin shale layers	39.5		SS		50					
Bedrock- Hard, competent, fractured, sandstone; thin iron bands; 100% lost circulation.	41					RQD = 49				

Soil Tests

Well Construction Diagram

DH-3

Nested Piezometers
DH3a - Deep
DH3b - shallow



Continued on next page

DRAWN: Michele Lemieux

CHECKED:

PROJECT: Deadmans Basin

LOCATION: Crest sta 6+55

BORING DATE: 05/16/98 **DATUM:** 3933 **DIP:**

Drill Hole No. 3

Page 2 OF 2

LOGGED: Jim Robinson

DEPTH SCALE: METRES 16–30; FEET 50–100

BORING METHOD: Hollow Stem Auger

DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	ID	TYPE	RECOVERY (%)	"N" VALUE
Bedrock- Hard, competent, fractured, sandstone; thin iron bands; 100% lost circulation.	▒					
increasing interbedded shale layers;	▒	66.3				
END OF HOLE @ 69.00ft		69.00				

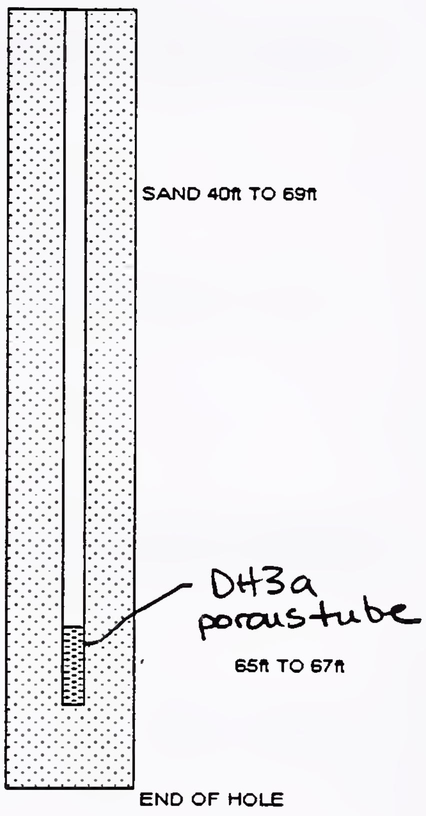
RQD = 89

K = 1.37 ft/day

RQD = 47

Well Construction Diagram

DH-3



DRAWN: Michele Lemieux

CHECKED:

PROJECT: Deadmans Basin

LOCATION: Crest Sta 7+10

Drill Hole No. 4

Page 1 OF 2

BORING DATE: 05/18/98 **DATUM:** 3393.0 Ground Surfac **LOGGED:** USBR

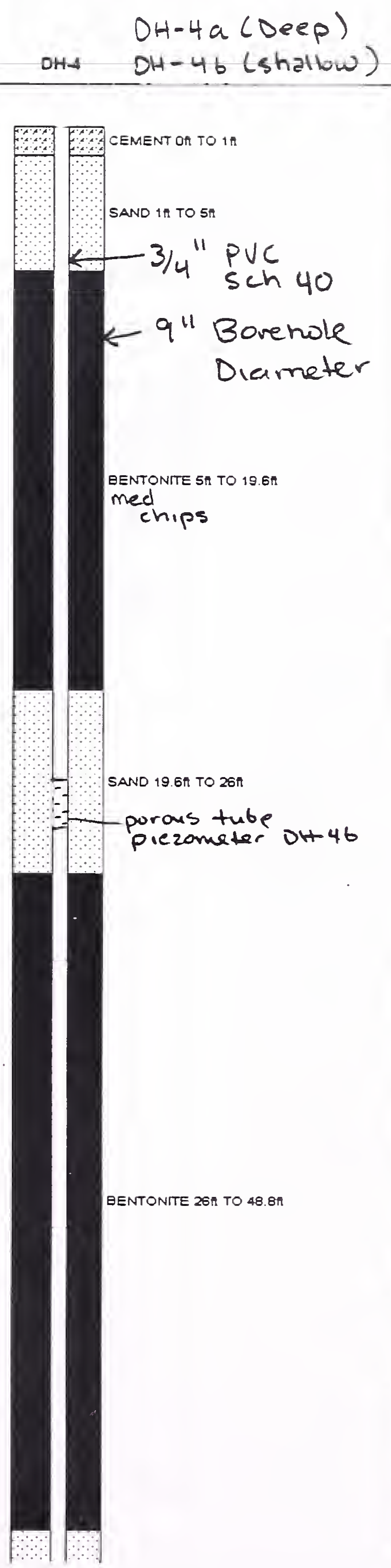
DEPTH SCALE — METRES: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 — FEET: 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50

BORING METHOD: Hollow Stem Auger

SOIL PROFILE: DESCRIPTION	DEPTH B.G.S. (ft)	SAMPLES: ID	TYPE	RECOVERY (%)	"N" VALUE	Soil Tests: PI	LL	% G	% S	% F
3393										
Road Material - Gravelly, clayey sand; loose, dry	0									
Embankment Fill - sandy lean clay (CL); increasing sand and gravel with depth; occasional thin sandy layers; minor roots/charcoal 24' to 34' (native ground?)	2		ss	100	9					
			ss	106	12					
			ss	100	3					
roots - minor			ss	93	5					
Roots - minor			ss	100	5	20	36	0	39	61
wet, some sandstone rock,	34.7		ss	93	12					
			ss	100	2					
Fine sand	42.2		ss		50			0	88	12
Sandstone	45.5									

Continued on next page

Well Completion Diagram



DRAWN: Michele Lemieux

CHECKED:

PROJECT: Deadmans Basin

LOCATION: Crest Sta 7+10

Drill Hole No. 4

Page 2 OF 2

BORING DATE: 05/18/98 **DATUM:** 3393.0 Ground Surfac **DIP:** **LOGGED:** USBR

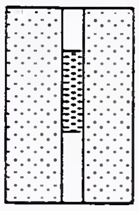
DEPTH SCALE METRES	DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	SAMPLES ID	SAMPLES TYPE	SAMPLES RECOVERY (%)	SAMPLES "N" VALUE	CONCENTRATION (%) LEL ◆ MOISTURE CONTENT ● GAS CONCENTRATION ■ 0 20 40 60 80 100
16	50–54	Hollow Stem Auger	Sandstone	▨						
17–30	54.7–100		END OF HOLE @ 54.70ft • TD voluntary • exact contact between embank. + foundation not well defined in log.		54.70					

METRES: 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

FEET: 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100

Well Completion Diagram

DH-4



SAND 48.8ft TO 54.7ft

porous 51ft TO 53ft

tube DH4a

END OF HOLE

DRAWN: Michele Lemieux

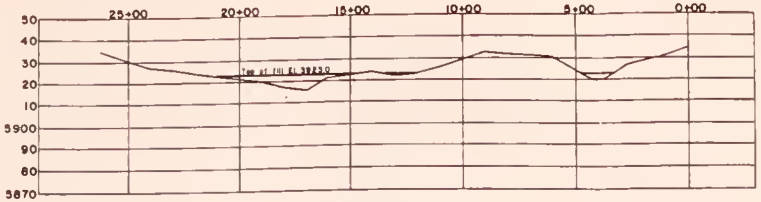
CHECKED:

APPENDIX E

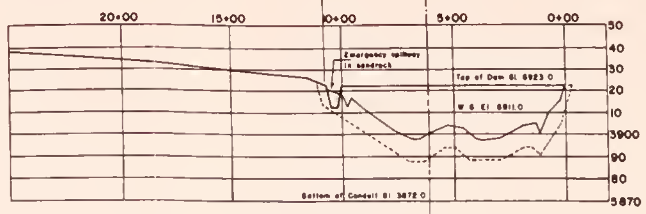
PROJECT DRAWINGS

(NOTE: These reduced project drawings are design drawings and not "As Builts". These drawing should be used for reference only. The SWPB has the full size project drawings.)

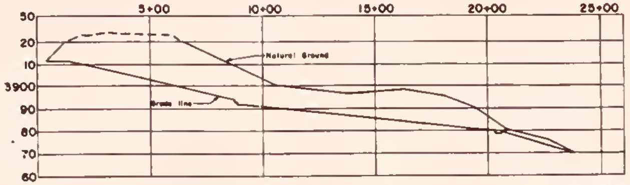
CONTOUR	AREA IN ACRES	STORAGE AC. FT.
3860	0	0
3872	616	4900
3875	785	6426
3880	895	11000
3885	1182	16500
3890	1337	66780
3893	1482	29750
3900	1617	37500
3905	1750	46000
3910	1876	55000
3911	1895	57000
3915	1961	65000
3918	2016	71850



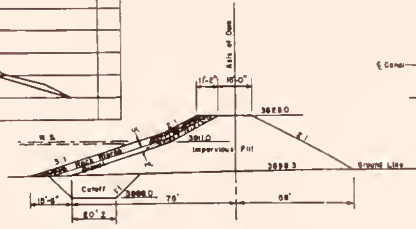
PROFILE—FILL NO. 2
Scale 1" = 300' Hor
1" = 30' Ver



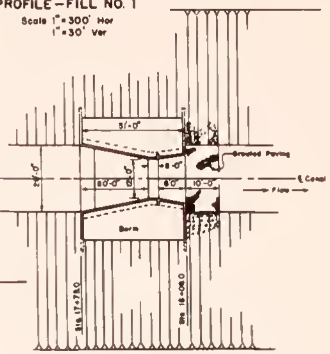
PROFILE—FILL NO. 1
Scale 1" = 300' Hor
1" = 30' Ver



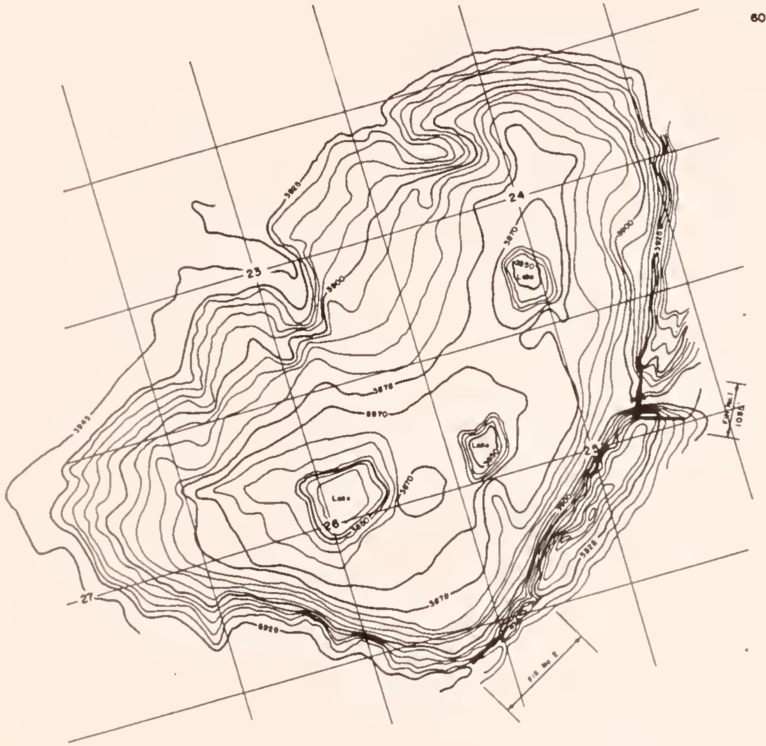
PROFILE OF SPILLWAY
Scale 1" = 300' Hor
1" = 30' Ver

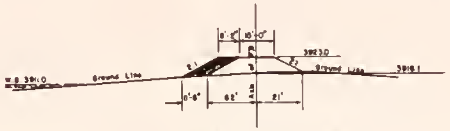


MAXIMUN TYPICAL SECTION—FILL NO. 1
Scale 1" = 30'

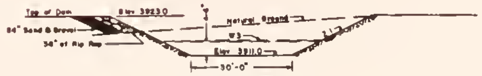


MEASURING FLUME—PLAN
Scale 1" = 20'

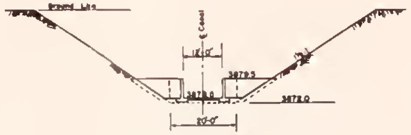




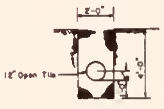
MAXIMUN TYPICAL SECTION—FILL NO. 2
Scale 1" = 30'



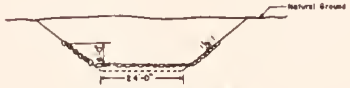
SECTION THRU DAM
Scale 1" = 20



SECTION THRU MEASURING FLUME
Scale 1" = 20'



SECTION THRU DAM



TYPICAL CANAL SECTION
Scale 1" = 20'

RESERVOIR MAP SHOWING
FILLS, MEASURING FLUME & DRAIN TRENCH

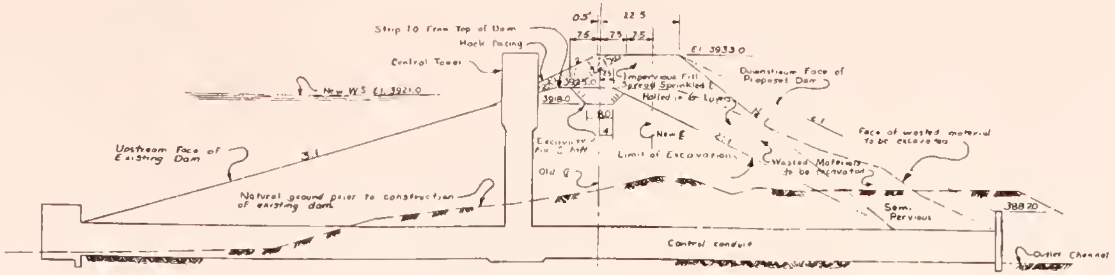
DEADMAN'S BASIN PROJECT
WHEATLAND COUNTY

STATE WATER CONSERVATION BOARD

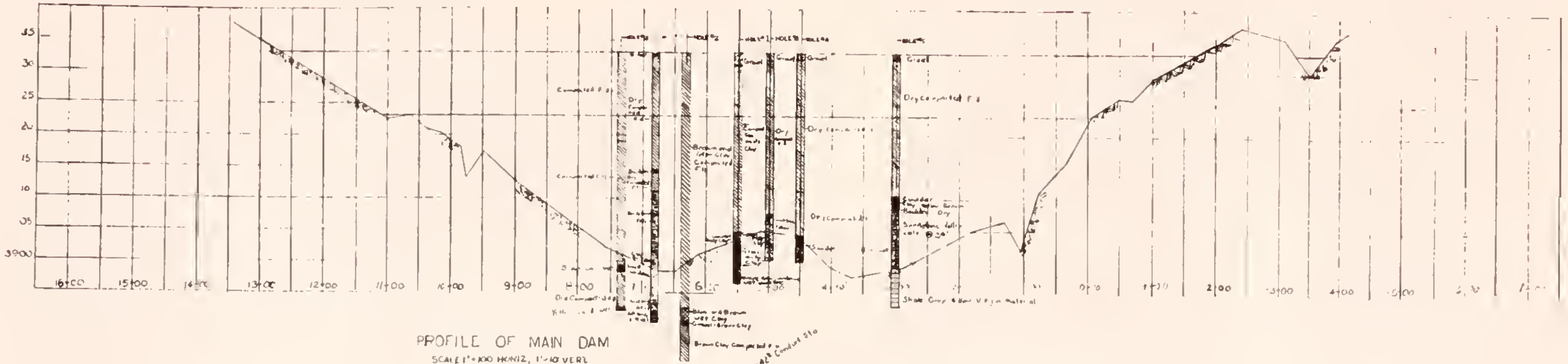
HELENA, MONTANA — MARCH, 1940
SCALE AS SHOWN — DRAWING NO. 92-15

Drawn	P.K.W.
Traced by G. Taylor June 1976	

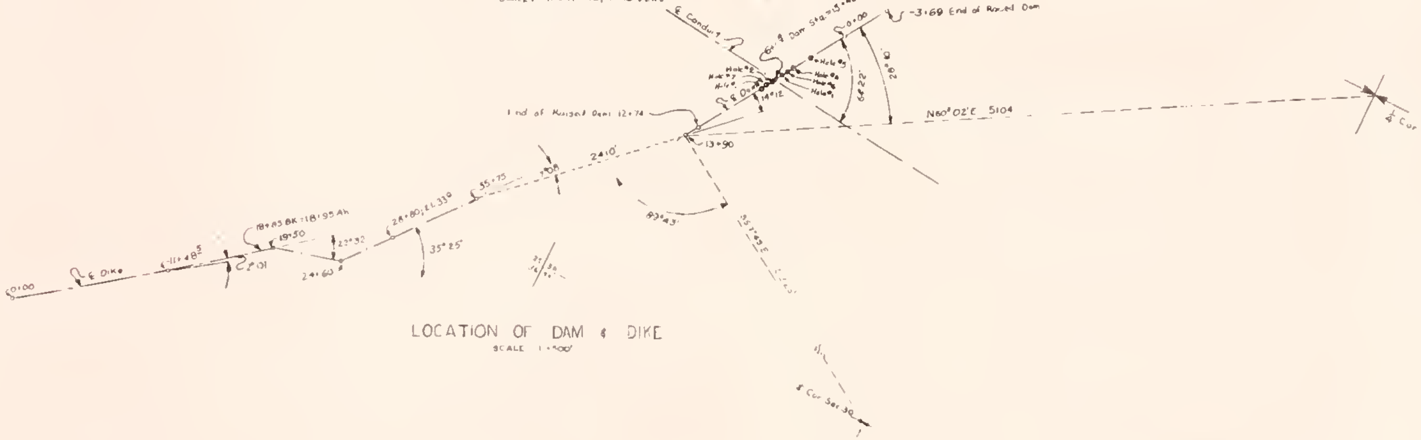
#5-93-37


Strip 10 From Top of Dam
Rock Facing
Control Tower
New W.S. El. 3921.0
El. 3933.0
3925.0
3918.0
Impervious Fill Spread Sprinkled Rolled in 6" Layers
Downstream Face of Proposed Dam
Face of wasted material to be excavated
Upstream Face of Existing Dam
3:1
Limit of Excavation
Wasted Material to be excavated
Old ℄
Natural ground prior to construction of existing dam
Semi Pervious
3887.0
Control conduit
Outlet Channel

SECTION THRU CONDUIT
SCALE ~ 1" = 20'



PROFILE OF MAIN DAM
SCALE 1"=100 HORIZ, 1"=10 VERT.

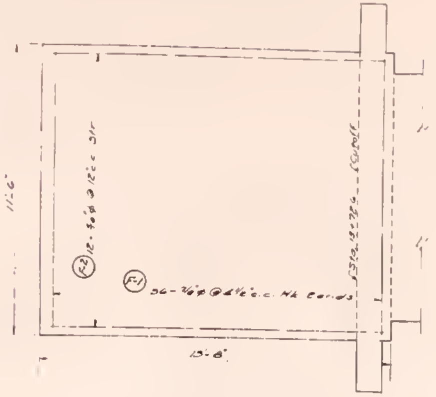


LOCATION OF DAM & DIKE
SCALE 1" = 500'

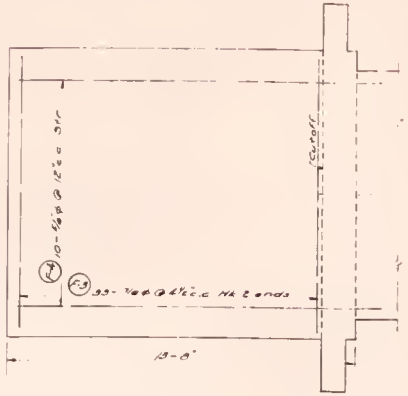
DRILL HOLE LOCATIONS
DEADMANS BASIN PROJECT
GOLDEN VALLEY COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA JULY 1967
SCALE AS SHOWN
DWG NO 92-

Drn By TY 20-VI-67

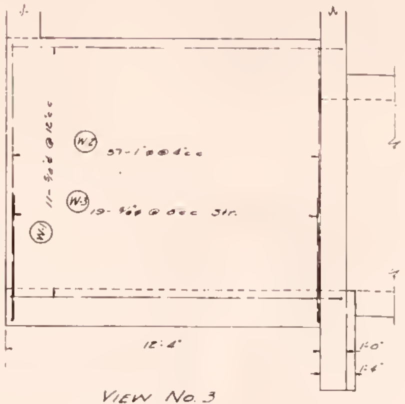
5-92-90



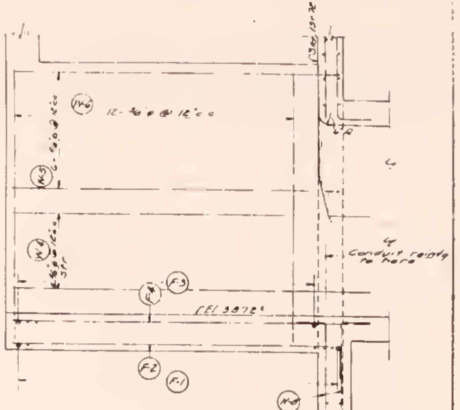
VIEW No 1
Scale 3/16"=1'-0"



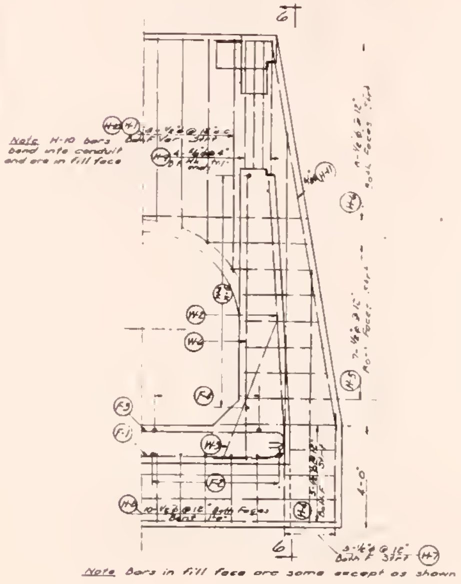
VIEW No. 2
Scale 3/16"=1'-0"



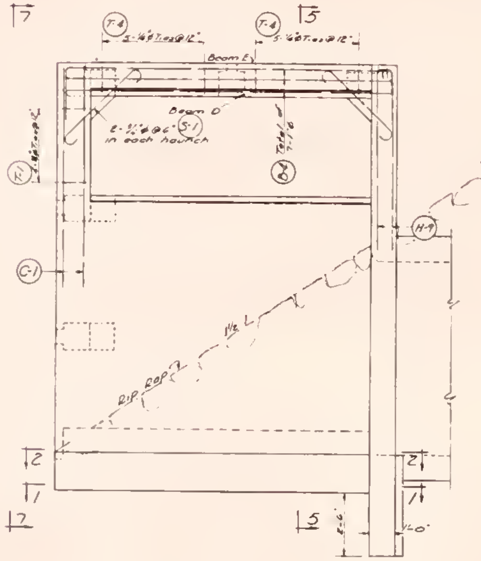
VIEW No. 3
Scale 3/16"=1'-0"



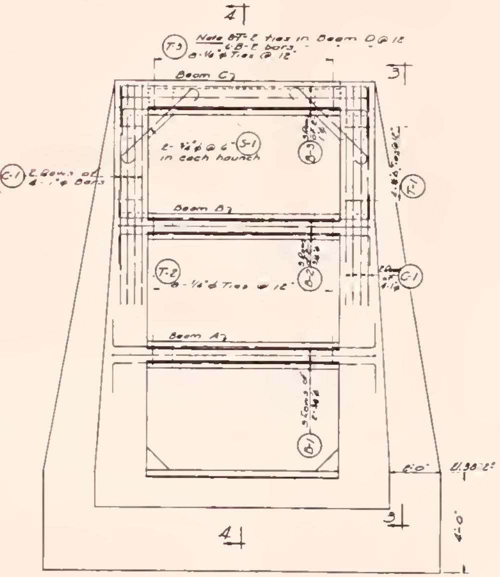
VIEW No. 4
Scale 3/16"=1'-0"


6
Note H-10 bars bend into conduit and are in fill face
H-10
H-11
H-5
H-4
H-3
W-8
W-6
F-4
F-3
F-1
W-5
F-2
H-2
H-1
H-7
4'-0"
6
Note Bars in fill face are same except as shown

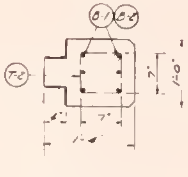
VIEW No 5
Scale 3/16"=1'-0"



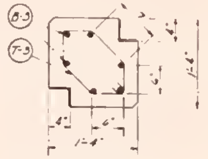
VIEW No 6
Scale 3/16"=1'-0"



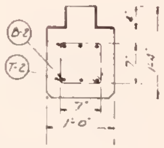
VIEW No 7
Scale 3/16"=1'-0"



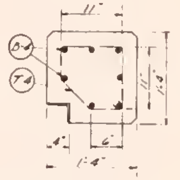
BEAM A & B
Scale 1"=1'-0"



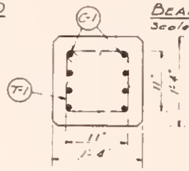
BEAM C
Scale 1"=1'-0"



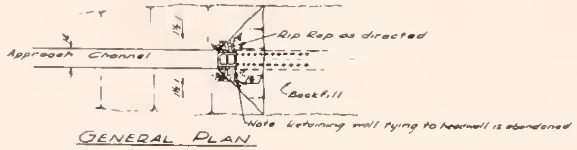
BEAM D
Scale 1"=1'-0"



BEAM E
Scale 1"=1'-0"



COLUMN

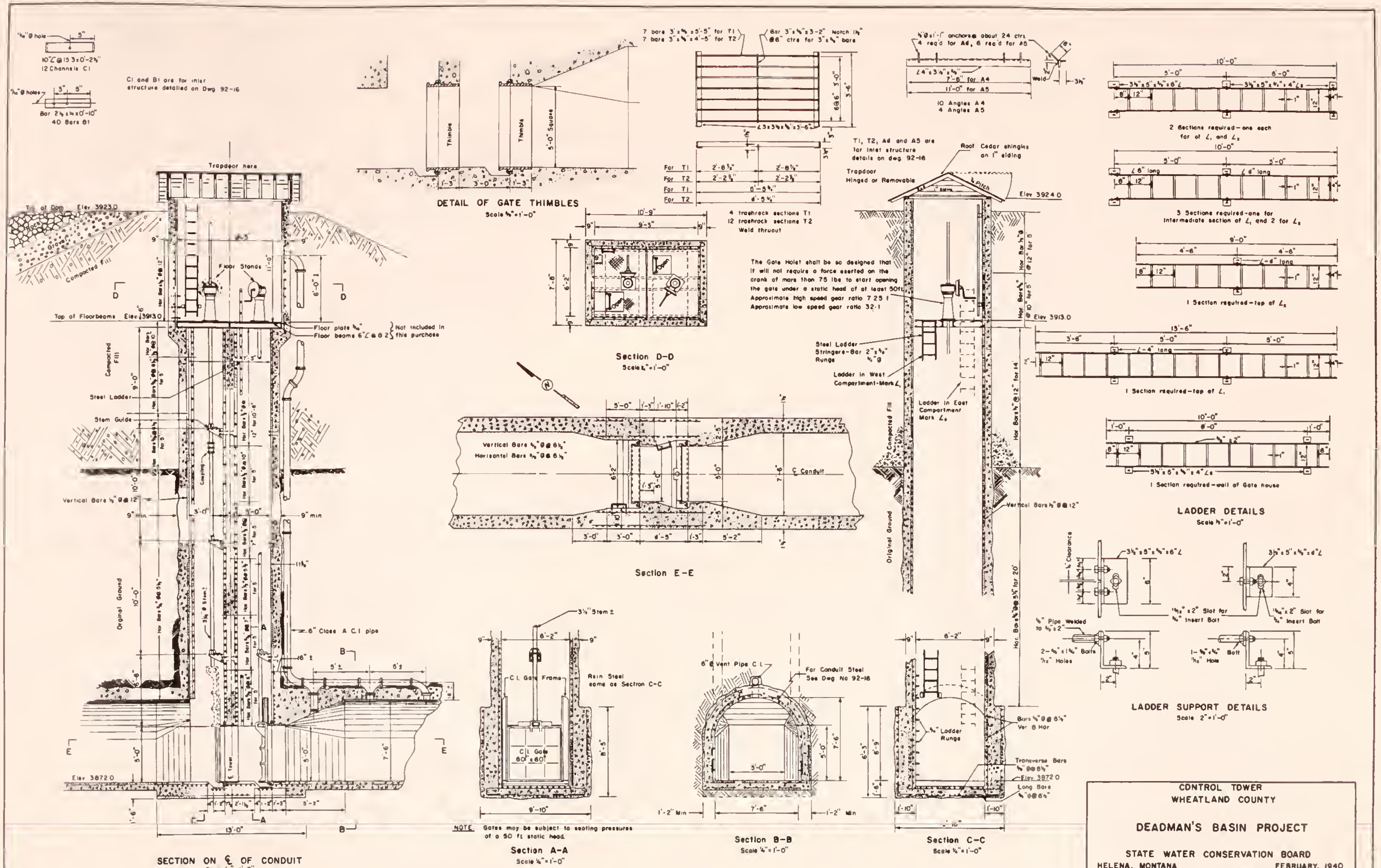


GENERAL PLAN
Scale 1"=50'

Note Headwall dimensions are revised
All other dimensions are as shown
on Drawing No 92-16

INLET REINFORCING DETAILS
LOWER MUSSELSHELL PROJECT
DEADMANS BASIN
WHEATLAND COUNTY
STATE WATER CONSERVATION BOARD
Helena Montana
Sept 21, 1940
Scale as Shown
Drawing No 92-26

Drawn by	L H	
Revised 10/4/40	L H	



The Gate Hoist shall be so designed that it will not require a force exerted on the crank of more than 75 lbs to start opening the gate under a static head of at least 50ft. Approximate high speed gear ratio 7.25:1 Approximate low speed gear ratio 32:1

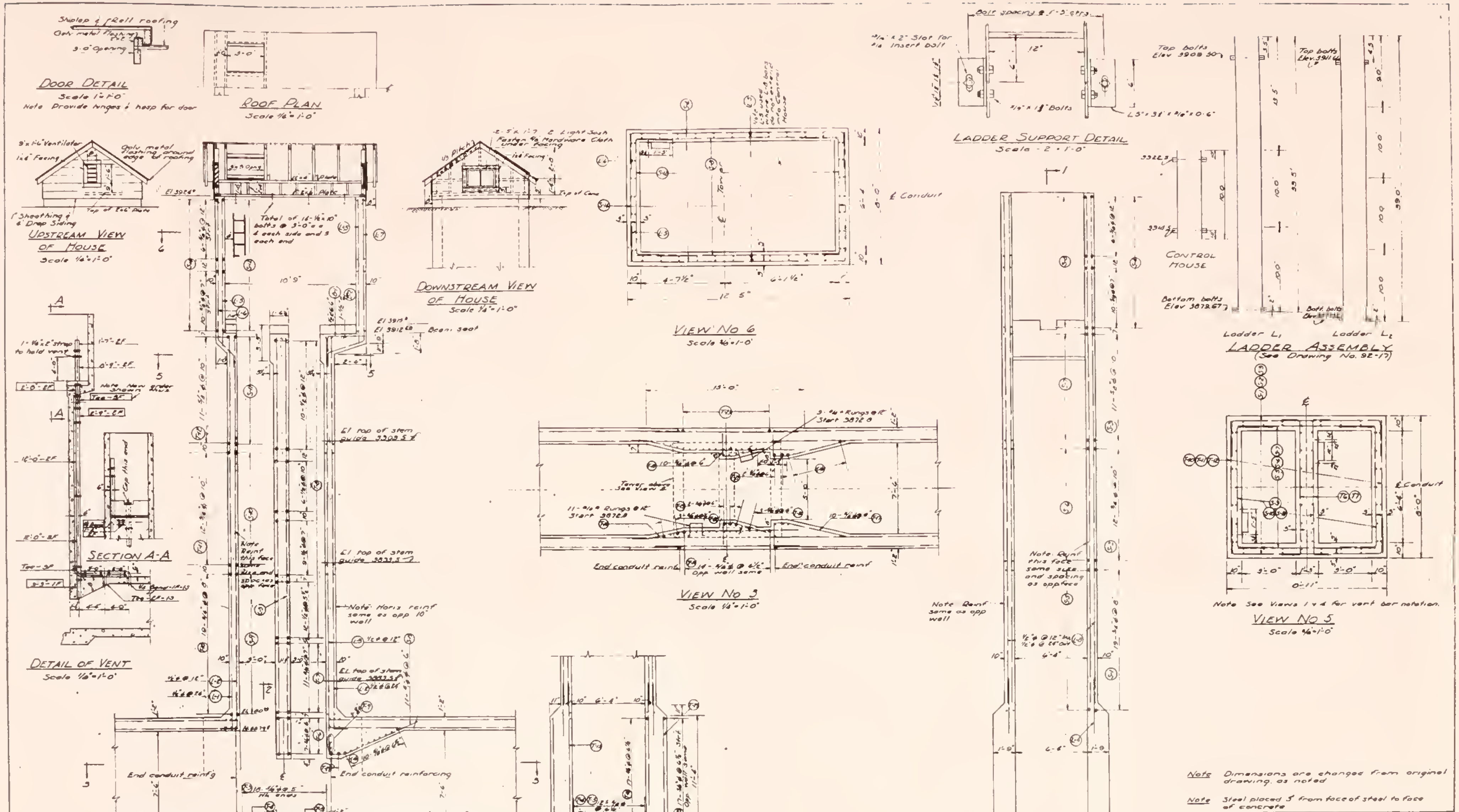
NOTE Gates may be subject to seating pressures of a 50 ft static head.

CONTROL TOWER
WHEATLAND COUNTY

DEADMAN'S BASIN PROJECT

STATE WATER CONSERVATION BOARD
HELENA, MONTANA FEBRUARY, 1940
SCALE AS SHOWN
DRAWING NO. 92-17

Drawn P K W	Revised 8/19/40 A C H
Revised 5/14/40 L H	Traced by G Taylor July 1976

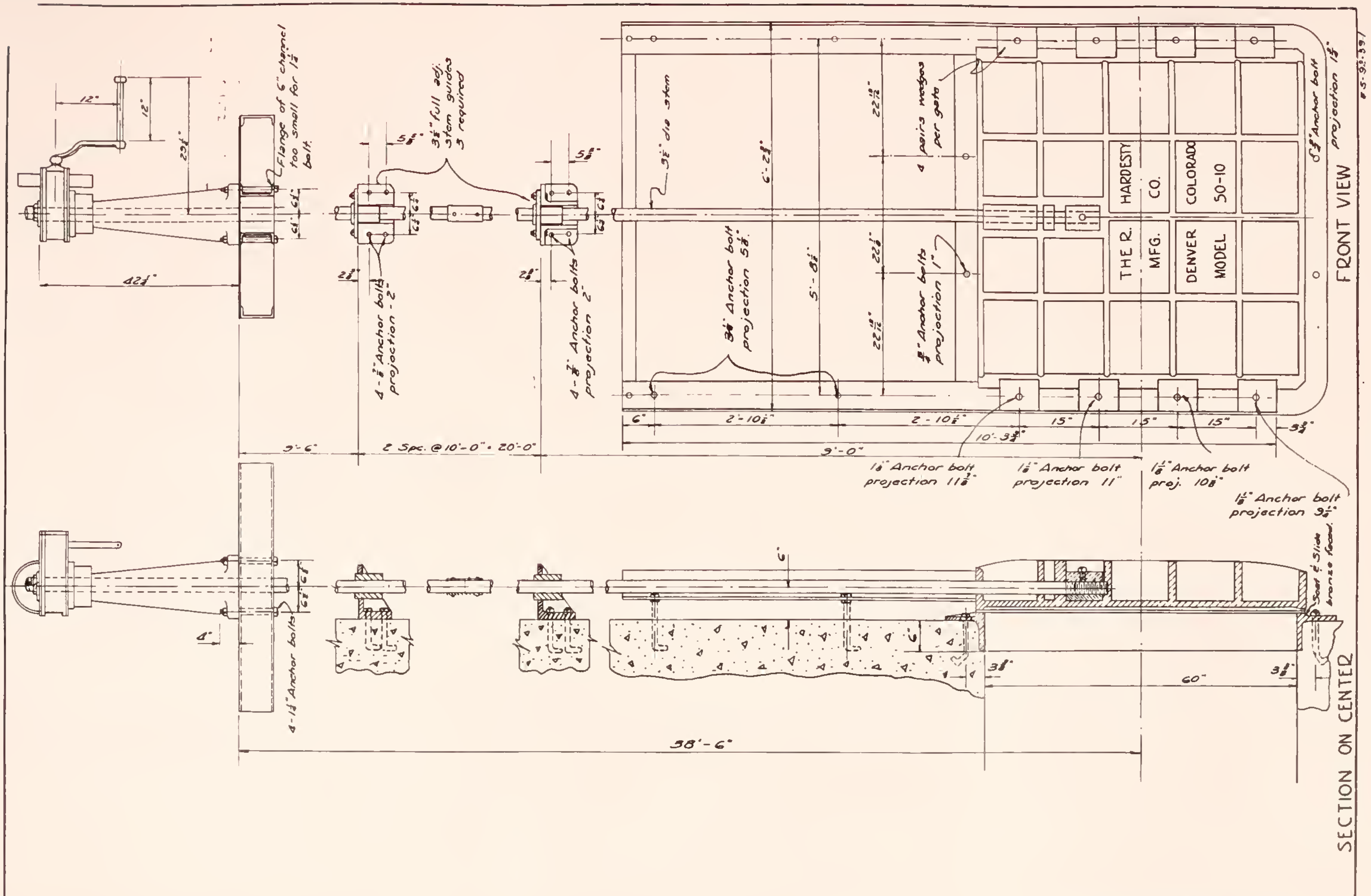


Note: Dimensions are changed from original drawing, as noted

Note: Steel placed 3" from face of steel to face of concrete

CONTROL TOWER REINFORCING DETAILS
LOWER MUSSELSHELL PROJECT
(DEADMANS BASIN)
WHEATLAND COUNTY
STATE WATER CONSERVATION BOARD
Helena: Montana Sept 13, 1940
Scale as Shown
Drawing No 92-27

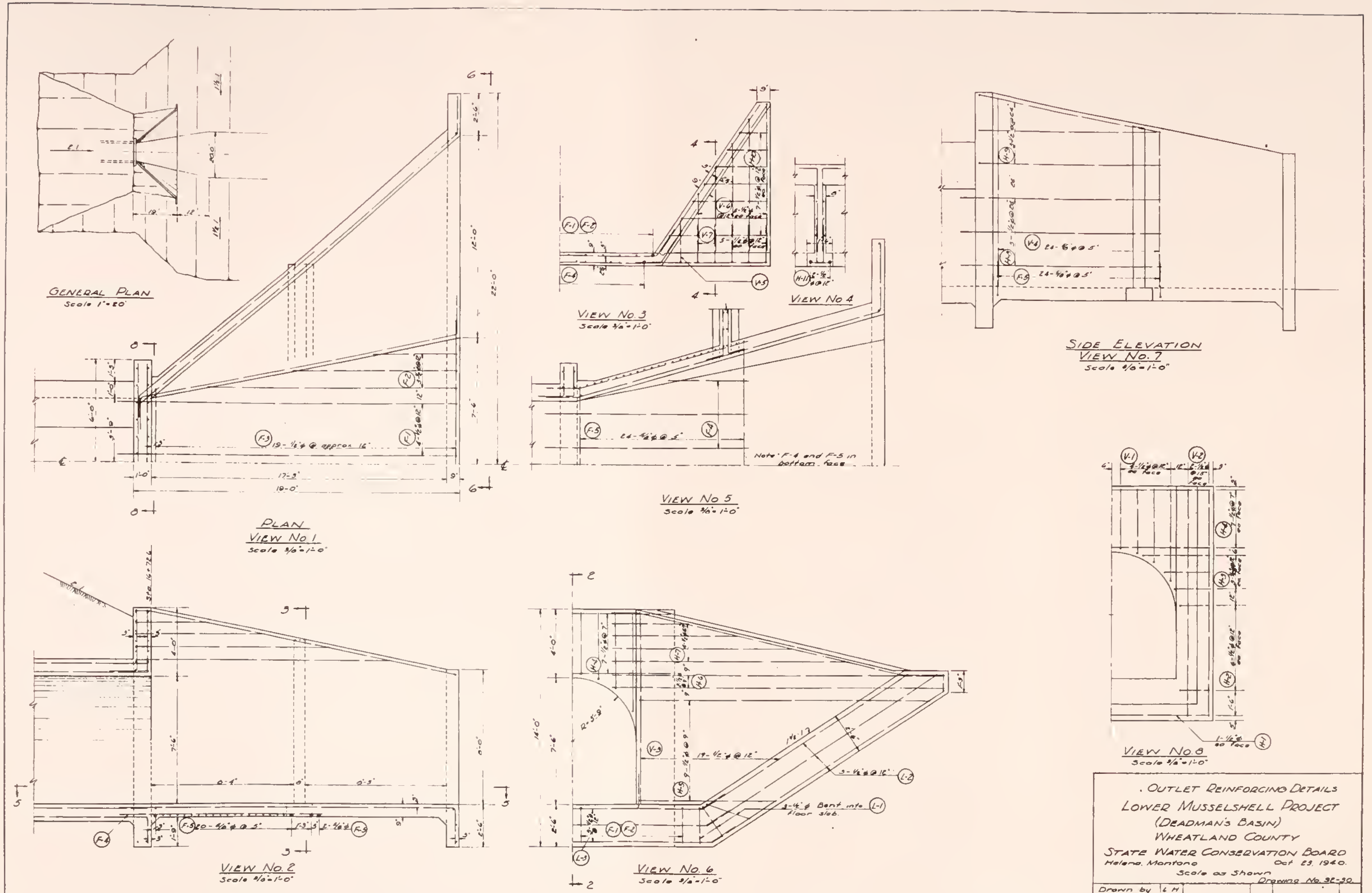
Drawn by	L H	
Revised 10/3/40	L H	


FRONT VIEW
SECTION ON CENTER
12"
12"
29¼"
42¼"
Flange of 6" channel too small for 1¼" bolt.
5⅝"
3½" full adj. stem guides 3 required
5⅝"
2⅜"
2⅜"
4 - ⅞" Anchor bolts projection - 2"
4 - ⅞" Anchor bolts projection 2"
3½" dia stem
6'-2⅞"
5'-8⅛"
22½"
22⅞"
22½"
¾" Anchor bolts projection 5⅛"
4 pairs wedges per gate
⅞" Anchor bolts projection 1"
THE R. HARDESTY MFG. CO.
DENVER COLORADO
MODEL 50-10
5⅞" Anchor bolt projection 1⅝"
6"
2'-10⅛"
2-10⅛"
10'-3⅜"
15"
15"
15"
3⅝"
9'-0"
9'-6"
2 Spc. @ 10'-0" = 20'-0"
1⅛" Anchor bolt projection 11⅞"
1⅛" Anchor bolt projection 11"
1⅛" Anchor bolt proj. 10⅜"
1⅛" Anchor bolt projection 9⅛"
6"
4"
4-1⅛" Anchor bolts
3⅛"
60"
3⅛"
Seat & Slide bronze faced.
38'-6"

THE R. HARDESTY MFG. CO.
DENVER, COLO.

INSTALLATION DRAWING
FOR 60" DIA. MODEL 50-10 GATE
DEADMAN'S BASIN PROJECT-MONTANA

Revised	Drawn by J.E.J.	Traced by H.S.B.	Dwg. No. 5217
	Checked by D.J.E.	Scale 1" = 1'	Order No. A. 7235



. OUTLET REINFORCING DETAILS
LOWER MUSSELSHELL PROJECT
(DEADMAN'S BASIN)
WHEATLAND COUNTY
STATE WATER CONSERVATION BOARD
Helena, Montana Oct 23, 1940.
Scale as Shown
Drawing No. 32-30.

Drawn by L H

05-08-56